SEP 29 1944

Soybean Digest

SILVER JUBILEE ISSUE

25 Years of Soybean History

1920 - 1944

Official Publication

OF

THE AMERICAN SOYBEAN ASSOCIATION

VOLUME 4 • NUMBER 11 SEPTEMBER • 1944

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THE *Soybean Digest*

GEO. M. STRAYER, Editor KENT PELLETT, Managing Editor

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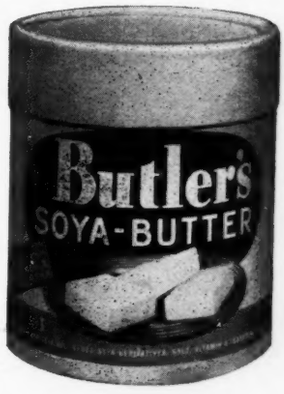

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BUTLER FOOD PRODUCTS

CEDAR LAKE, MICH.

W. J. Morse with some of the many food products that can be made from the soybean.

Bill Morse-- Soybean Daddy

● *Dr. W. J. Morse has been called the daddy of soybean growing in the United States. And rightly, for he more than any other man living is responsible for the tremendous soybean industry. The author is an employee in the Division of Forage Crops and Diseases at Beltsville, Md.*

By MARY BURR PIETERS

GRASSES and legumes, their improvement, development and utilization are the primary interests of the Division of Forage Crops and Diseases. Any grass or any legume that offers promise anywhere in this country is studied and considered and out of this study and consideration has come some most extraordinary results; results that have enriched a nation and an agriculture. We have some favorite stories of our accomplishments that we like to tell. For example we like to tell our story of soybeans and of the man who did the job — a job that enriched the nation by well over half a billion dollars in 1942.

Soybeans were first mentioned in American literature by Mease in 1804 who writes, "The soybean bears the climate of Pennsylvania very well. The bean ought to be cultivated." But the first real impetus that the crop got in the United States was not until over a hundred years later when a man of great vision and drive — the late Charles V. Piper, then in charge of the division, saw the possibilities and needs for the soybean in this country. He went further — he knew the man to promote the crop, picked him and put him to work. That was in 1907. The man was and is William J. Morse. Morse, just out of Cornell, had the enthusiasm and adaptability of youth and Piper spurred him on. Dr. Piper died in 1926 and then Morse was on his own. Being "on one's own" in the Division of Forage Crops and Diseases has special meaning. The men who have directed the affairs of this division have happily been endowed with a fine sense of understanding and a gift for cooperation and have extended to each man under their supervision an opportunity to go the limit on any piece of work he had undertaken. Morse took full advantage of this opportunity and what he has done with soybeans between 1926 and 1943 sounds much more like fiction than hard facts, facts that are being translated with telling effects toward feeding a nation and winning a war.

Morse put every other scientific consideration and ambition and every other hobby out of his mind and fixed his gaze on soybeans. He studied, he traveled, he toiled, he experimented — he exhorted — and the result of all of this singleness of purpose and devotion surely borders on the fantastic. A crop that had been the mainstay of Oriental peoples for centuries got its roots deep into the good soil of the Cornbelt and the not-so-good soil of the Cottonbelt states and liked it.

Not all varieties liked all locations nor suited all needs. Morse went back to Manchuria, China, to Japan, or wherever he thought what he wanted was to be found, brought it back, set to work studying and developing and pretty soon just what was needed for a given location or need was available. The conditions under which this crop will grow and the uses to which it may be put have reached astronomical figures and its potentialities have not yet been exhausted, not by a long way. It supplies good and abundant food for all sorts of livestock, and being a legume it adds nitrogen to the soil; its seed is abundantly and inexpensively produced and yields high quality oil; it is a component of almost all of the new industrial plastic products; it is an admixture of many foods and an ally to the nation's health. At Urbana, Ill., a Regional Soybean Laboratory has been established as a center for soybean improvement and production in this country with Mr. Morse as project leader.

Dr. C. V. PIPER—He pushed Morse into Soybeans.

Modest and retiring, but sure and right as rain Morse goes right on digging deep into his experience and resources, pulling new rabbits out of his hat with each new product placed on the market, with each new record rolled up. He is the author with Dr. Piper of *The Soybean,* published by McGraw-Hill in 1923, and of many Department of Agriculture bulletins and scientific papers. He was the president of the American Soybean Association in 1924.

EDITOR'S NOTE.—Dr. Morse might be called the daddy of the American Soybean Association as well as of the soybean in America, since our organization has probably leaned on him more than any other man through the years. He has always been a guiding light and has missed few, if any meetings. It is doubtful if anyone else can equal this record.

Soyland Saga

By TAYLOR FOUTS
Camden, Ind.

● *Taylor Fouts was growing soybeans 40 years ago. First meeting of A. S. A. was held on his farm, Soyland, and he served as president in 1920 and 1928. He gives an account of his experiences with the crop.*

Here is the Fouts family. From left to right, Taylor, Pauline, Mrs. Fouts, and Mary Margaret. The author says the wedding of himself and Mrs. Fouts was postponed for soybean threshing.

ACCORDING to Dr. W. J. Morse, the soybean was first introduced in our country in 1804, about a century before any notable attempt was made in the great Cornbelt to adopt it as a worthwhile farm crop.

About the turn of the century the U. S. Department of Agriculture, being aware of the potential worth of a seed-bearing legume, began to distribute soya seeds to farmers for experimental purposes. Some seeds fell on fertile soil, such as the hands of Isaac Smith (Soybean Smith), of Warren, Ind. He talked and wrote about them, and his experience and observations were "good news" to many farmers confronted with clover problems, and more efficient rations for their livestock. All glory to this man of the late nineties.

About 1896 or 1898 my father was recipient of free seeds from the U.S.D.A. These included two varieties of cowpeas and two varieties of soybeans. These were drilled across a cornfield, one row each, and attracted considerable attention by the end of the season, particularly the soybeans because of their erect growth and promising seed production. A lasting impression was made upon the lad who resolved to do something about them when the school years were over. Doubtless much seed fell on other fertile soil and may have aroused sufficient interest to start a soybean nucleus in many parts of the Cornbelt.

It was during Purdue years that this dreamer became convinced that the whole Cornbelt needed soybeans and would like them for keeps. So in the spring of 1904 seed was collected from the Indiana Experiment Station and Soybean Smith, enough to plant 4 acres, 1 acre each of Ogemaw, Ito San, Early Brown and Hollybrook. The seed-bed was too fine, the seed was drilled too deep, rains were heavy. Lesson No. 1 was almost a knockout. Fortunately a few spots came through and proved their worth by a splendid growth. I mowed with a scythe and doodled, flailed out the precious seed on the barn floor, and prepared it for another trial in 1905. More soys each year and by 1907 the varieties were Ito San and Hollybrook.

Incidentally, Mrs. Fouts was obliged to postpone her wedding day until those soybeans were threshed. We finally set October 24 as being amply late, but I just finished threshing at noon that very day. We were married at 3 p. m. and were off for the long-planned honeymoon.

So 1907 was an eventful year for three reasons: (1) our father completed his career, a true, typical pioneer of 80 years, prosperous and honored; (2) I had 200 bushels of seed beans, a unique possession; and (3) I had a companion for a home, a true helpmate indeed.

By 1908 we ventured drilling soybeans with the corn, so that our western lambs to be purchased in September would have a more balanced ration. My two older brothers took readily to this plan and thereafter grew soybeans as a habit.

DEMAND FOR SEED

Our seedstock seemed in demand due to more publicity by the agricultural press and county agents. Answering questions about kinds, planting, inoculation, cultivation, harvesting and that headache, threshing, required lots of time, so that well prepared circulars were needed. Plenty of midnight oil was burned.

A soybean day in September 1910 was sponsored by the Purdue agricultural extension department and our county agent, and proved quite a help in creating interest in the crop. Report of this demonstration reached Illinois, and a few days later in drove two "suckers"—Chas. L. Meharry and Wm. Riegel, all the way from Tolono. They came in a new, open-top Buick roadster, with the cute single seat high up behind. I was interested in this car (although a new Ford was peeping out of the shed door) and they were intensely interested in soybeans. So we talked and walked and thus began the friendship that was to be mutually helpful through all the years. I think their visit in 1910 inspired the marvelous development of soybean production in Illinois.

Understand that the interest in soybeans all these years was for the farm—a seed and feed proposition. Our standard rotation was corn with soybeans, soybeans, wheat or oats, and clovers—a legume in the field every year. Commercial and industrial uses were frequently mentioned but neither volume of seed nor processing plants were as yet on sufficient basis. The price ranged for many years around $2.00 to $2.50 per bushel due to the big gamble in germination and seasonal demand, and the crude tools of production. By 1917 war prices began to show and up to $3.00 was a going price. In 1918 it was around $5.00 and I believe 1919 probably reached the peak at $6.00 to $8.00 a bushel. At the end of that period we were offered $10.00 per bushel so we scoured the community for remnants from seeding and shipped 30 bushels for $300.00.

FIRST ELEVATOR

An old pioneer type elevator was purchased at Camden about 1914, remodeled and equipped with recleaning and grading mill and elevators for preparing and storage of our seed beans. This was perhaps the first soybean elevator devoted exclusively to the handling and shipping of soybeans in the U. S.

Another soybean day was held at Fouts Bros. Farms in 1916—more acres, varieties and experiences, and more folks to see and talk. By this time there were regional meetings of this kind and interest was quite general. The name Soyland was adopted for the farm in 1918 and seemed to fit.

Thus with the general popularity of soybeans throughout all the Midwest states it seemed an opportune time in 1920 to stage a Cornbelt soybean conference. This was sponsored by Purdue's agricultural staff with county agents cooperating, and also ably assisted by the agronomy departments of the adjoining states and the U. S. Department of Agriculture crop specialist. It was deemed best to stage the meeting on some farm with a background of soybean experience and a going demonstration of how to grow and utilize the crop. Soyland about filled the bill. We responded for the occasion by seeding a number of variety plots. We grew 150 acres designed for seed and hay, and planted soybeans in over 200 acres of our corn. It was a favorable year and the demonstrations showed well. By the "Day" we had hay plots showing how and why. In the corn-bean field we had a sample load of black-faced lambs browsing on the luxurious soy-leaves, and how they liked their new home. The gaps in the fence were opened so the shotes roamed at leisure in the "paradise soon to be." Several neighbors also had excellent fields of soybeans.

Yes, "Soyland" was all set for September 3, 1920, and the weather man was kind indeed, for you notice it was cool enough to wear our coats. The soybeaners came from all the Midwest states and the U. S. D. A.—and some stragglers with pencils—over 1,000 of them. Inspection of the various fields was made during the forenoon.

At noon they all lined up for the cafe-

teria lunch that the Presbyterian Ladies Aid had so well planned. There were sandwiches galore, soybean salads, coffee and a sumptuous layout of pies. The soybeaners all crunched the roasted and salted soybeans as though they were a rare treat. Soybeans were even set to music that day, when a quartet of local growers sang a very appropriately worded song, "Growing Soybeans to Get Along."

It seemed an opportune time to form a definite organization. At that time the name, "National Soybean Growers Association," was appropriate, and that name was agreed upon. However, in a short time the industrial aspects of the potential crop indicated a more comprehensive name, and the American Soybean Association was adopted and has been most satisfactory.

The honor of being its first president was kindly bestowed upon the host of this first national field day, and its secretary was the late Chas. L. Meharry, *par excellence*. It was unanimously agreed that a soybean field day be held each year as a vital activity of the Association.

Now, the story of soybeans in America may be likened to a stream of water. Its springs of joy and beneficence so long obscured could no longer be held back by doubts and fears, prejudice nor competition, and simply must burst forth to flow down into the rich valley of appreciation and opportunity. Our gratitude goes to all who have attended and straightened the course of this little streamlet, to those who have brushed aside some of the obstacles and boosted its flow into broader fields of service. The inoculation laboratories, plant breeders and investigators, agronomists, research laboratories, and the agricultural press have all been tributaries that have increased the flow and volume of this marvelous product to mankind. Thus the little streamlet is now a formidable river surging with its possibilities for both agriculture and industry, and is destined to greatly affect the prosperity and welfare of our nation.

—s b d—

SOYBEANS

By TAYLOR FOUTS

First pub. in Vol. II of the Association's Proceedings.

Soybeans! Soybeans! You're like a Musical Band
To the Farmer who's tuned for the "Best on his land."
Microbic Composers, on the millionth wave length,
Sing "love" to the Rootlets as they're reveling in strength.
The Chlorophyll hums in the rays of "Ole Sol,"
And frosts, rains and winds are a "medley with Soys."
The "Pop o' the Pods" is Jazz to the Pigs—
Puts pep in the Porkers—they grunt and grow big.
The "Rustle o' Leaves" to the Lamb is sublime,
He waltzes right up in full zest and on time.
The harvests of hay, pastures and seed-time
Give enchantment to tune and thrill to the chime.
The Kiddies they hop to the "Jingle o' Coin"
That Daddy rakes in while Soy Music's a goin'.
Oh! Soybeans! Soybeans! You're a symphony grand
To the Farmer who's tuned for the "Best on his Land."

It's

Fun to Remember

● *The author, now a farm manager, was formerly a member of the faculty at Purdue University. He was one of the starting spirits of A. S. A. and served as its secretary for the first four years. Here are his recollections of the first meeting.*

By W. A. OSTRANDER

LaFayette, Ind.

THE TWENTY-FIVE years didn't take long to pass. Soybean history years always roll along quickly. The American Soybean Association grew out of the soybean campaign that was started in 1920 in Indiana because we needed a larger acreage of legumes in the cornbelt rotation. Clover was failing us possibly because of soil acidity, its biennial growth, or things we didn't know anything about. Soybeans looked like an answer.

It took a lot of tall stories about the value of soybeans to get the ball rolling. Some of these stories were based on solid facts, some on put together facts and some on just wishful thinking. It was a strange fact though after telling all of these stories so many times, wild as some of them were, we believed them ourselves. And what has surprised us as much as anything is the fact that most of the stories have come true with still wilder ones added to the lot. That is the way with soybeans—start them out and they go places themselves.

It was in the fall of 1920 that we in Indiana decided to have a sort of statewide get-to-gether to see where we stood on the soybean situation, appraise what we had and outline where we were going. We had had county soybean field meetings over the entire state and it seemed right that we hold a big get-together to finish it up. As we worked out the plan for this meeting it occurred to us that a good neighbor policy would be to invite the growers and experiment station men from our surrounding states to join us. Start it off with a bang. So out of that which started to be a state meeting was a Cornbelt meeting and out of it the American Soybean Association. All this on the Fouts Bros. farms near Camden, Ind. Our idea was to take the soybeans to the farmer and the farmer to the fields of soybeans in his county. Conversion on the ground.

The response to this meeting was away above what A. L. Hodgson, County Agricultural Agent of Carroll County, and I had any reason to expect. Illinois, Ohio, Michigan, Wisconsin and Kentucky sent growers, county agents and men from the experiment stations. Over a thousand came. We fed them well. The start was made.

All speeches were limited to 3 minutes; it shut off some of the long-winded folks but it gave all a chance.

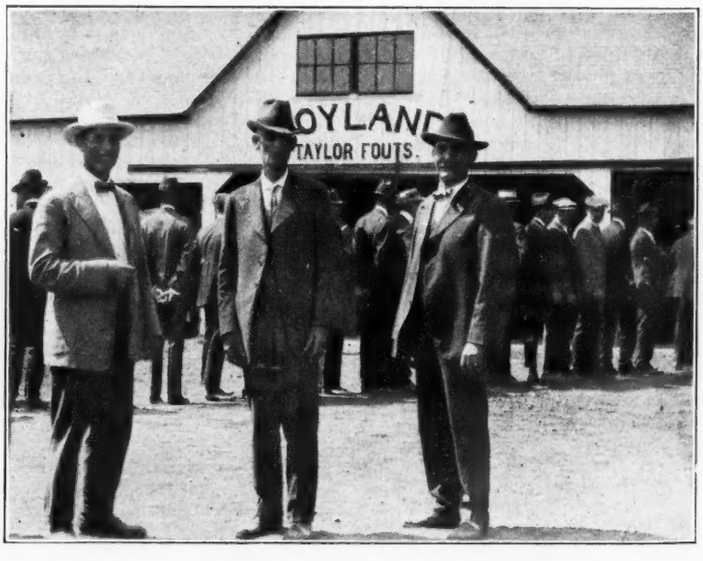
G. I. Christie reported for Indiana. He said we had 200,000 acres and thought he had the record stopped and I guess it was for the day. No one dared go higher, but this year it is just 10 times that amount, 2 million acres. In those days we counted every acre that had a bean on it, in the corn, for hay and for seed.

W. L. Burlison of Illinois said there were 25,000 acres in his state and more in sight. He was right. Last year they had 4 million acres.

George Briggs was modest in reporting 4,000 acres for Wisconsin and he still is

Birthplace of A. S. A.

The three Fouts brothers, from left to right, Taylor, Finis and Noah, at Soyland during the first meeting September 1, 1920.



modest for they had 115,000 acres there last year.

Wallace Hanger of Ohio surmised that Ohio had 15,000 acres and there the acreage is now 1,500,000.

Iowa reported 50,000 acres and now has 2,200,000 and still going strong.

C. R. McGee of Michigan said they were just getting going with 5,000 acres but they now have 150,000 acres.

MIGHTY PROUD

There were no government estimates on soybeans in those days so we each could tell our own story and it had to stick. They were not bashful reports either. Each state discounted the other's report about the same percentage so we all came out about the same. Harry O'Brien came over and wrote the meeting up for the *Country Gentleman*. We were mighty proud.

After visiting the soybean fields on the three Fouts Bros. farms, eating soybeans and talking our heads off and making many new friends, it was decided to hold a winter meeting at the time of the International Hay & Grain Show at Chicago, to keep the iron hot and to carry on. The first meeting was held on the bridge connecting the two exhibit rooms as we were not considered important or big enough to rate a room. Each year our numbers grew until we had to have the largest room they had. At these winter meetings we hashed over the latest soybean findings, worked on standards for the grading of the crop, talked over certification rules and always as a final job selected the state in which was to be held the summer meeting. Each year it was to be a different state.

Our first big problems were better varieties, methods of harvesting, and the utilization of the crop.

Just by a lucky break we brought the Manchu down from Michigan and this was our first unintentional success, a bean that was a "natural" for the Cornbelt at that time. It did well most everywhere for hay or grain and did not shatter as did those we had. We were growing largely the old so-called Hollybrook (the Association changed its name to the Midwest) and the Ito San was our early variety.

Our big headache was the harvesting of the crop. Any old way was the order of the day and the results were cracked beans, poor quality and a lot of work. A combine seemed to be the answer. A lot of wild tales and funny experiences could be told about the efforts of the following 5 or 6 years along this line. It was a free-for-all race and the devil did get a lot of the hindermost. It looks funny now but it wasn't so laughable then for we were all in dead earnest, we needed this combine so badly. It all worked out in due time, thanks to the cooperation of the several implement manufacturing companies.

Then came the utilization of the crop. Up to 1920 we had been using all soybeans produced in the Cornbelt for seed, for hay, hogging off and seed again. It was not a grain crop yet. We went to the oil extraction companies and they said sure we will put in additional machinery to take care of them as soon as you have the quantity to make it worth while. Back to the farmers we went but they came right back and said sure we will put in more acreage and glad to as soon as we are certain we can get rid of the crop at a fair price. So—there we were. It is too long a tale to tell all that came and went until the oil plant at Chicago Heights was taking all beans offered. It was the old hydraulic system and it worked fairly well. The late Russel East and I got the corn starch plant at Edinboro, Ind., to try some beans through their Anderson Expellers. It worked. It wasn't long then before Bloomington, Monticello and Taylorville, Ill., had plants and that chapter was ended.

It had not been hard to sell the idea to our farmers that they were wise to grow their own protein feed. That was a natural. When we fed the soybeans alone as a supplement the oil in the beans gave us soft pork and that was a black eye for a few years but now that, too, has been eliminated.

Where we fell down the worst, as I see it now, was that we did not stress the human food side stronger. We talked about it enough but got nowhere. The principal reason, I believe, was in our shortsightedness in not dropping the word "bean" and using just the word "soy." Let's give away half of the name after we work on the grain and open up the road to unlimited food uses of this best of all protein grains raised on our farms.

MANY STILL WITH US

One of the fine things as we look back over the past 25 years is that so many of the boys that were with us at that first meeting are still going strong for soys. I don't believe the old mainspring, W. J. Morse of the U. S. Department of Agriculture, has missed a single meeting, at least not of his own volition. Probably the ones we miss most are the two Fouts Bros., Noah and Finis, Charles Meharry and Dean J. H. Skinner. They were always on hand. You can not meet Burlison, Hackleman or Bill Riegel of Illinois without talking soybeans. George Briggs of Wisconsin is still his old soybean story self.

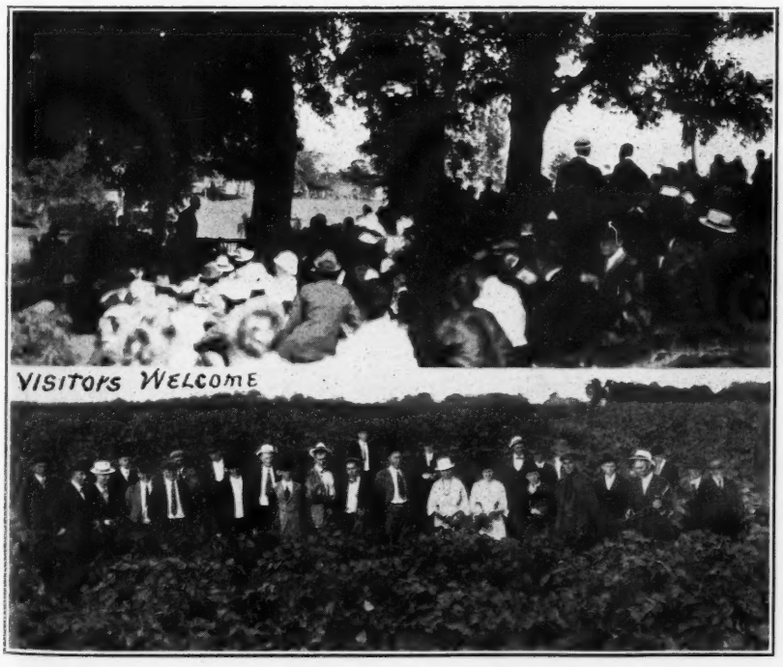
Helms of Missouri, McGee of Michigan and Hanger of Ohio still talk of that first meeting under the trees on the Fouts farm. Hughes of Iowa is as strong as ever for the beans and Christie, while he has been gone to Canada, this some time, can still tell a tall soybean story. Our own A. T. Wiancko here in Indiana, who guided us so well from behind the scenes, is still the active pusher for soys that he always was.

We have been making soybean history in the Association for the past 25 years. If we can go on as much farther in the next 25 years—soybean history will have been made.

—s b d—

1,000 at First Meeting

Views of the Soyland meeting. Speakers were limited to 3 minutes which shut off long-winded folks but gave all a chance. Many view the soybean fields. Attendance was far beyond that expected, with representatives from many states.



LINSEED MEAL SHORT

Iowa farmers accustomed to feeding linseed oil meal to livestock should plan on a 50 percent reduction in linseed meal supplies this fall and winter, according to a survey of feed supplies released by the Feed Institute of Iowa, at Des Moines.

Livestock feeders can, however, substitute soybean oil meal in making up for the linseed meal shortage, the Institute report said. "Soybean crushing facilities have been increased substantially, indicating that at least 20 percent more bean meal will be available to Iowa farmers during the coming season. The protein content of soybean meal is actually 14 to 22 percent higher than linseed meal, and when fed with a proper balance of other feed elements will give excellent results."

SOME EARLY PROCESSORS

In the early 1920's so few soybeans were harvested for seed that the amount was not reported by the U. S. Department of Agriculture. Yet even then the growers were scratching their heads over what to do with surpluses!

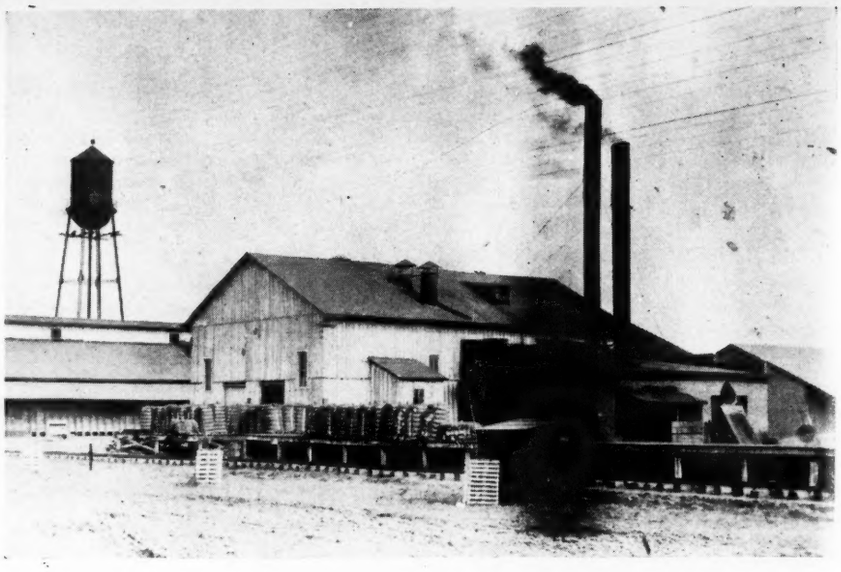
There could be no real soybean industry until the coming of processing plants. Without them, growers hesitated to expand acreage. But processors waited on a sufficient volume of soybeans so there would be at least a gambler's chance of profitable operations. It took some years to overcome this impasse.

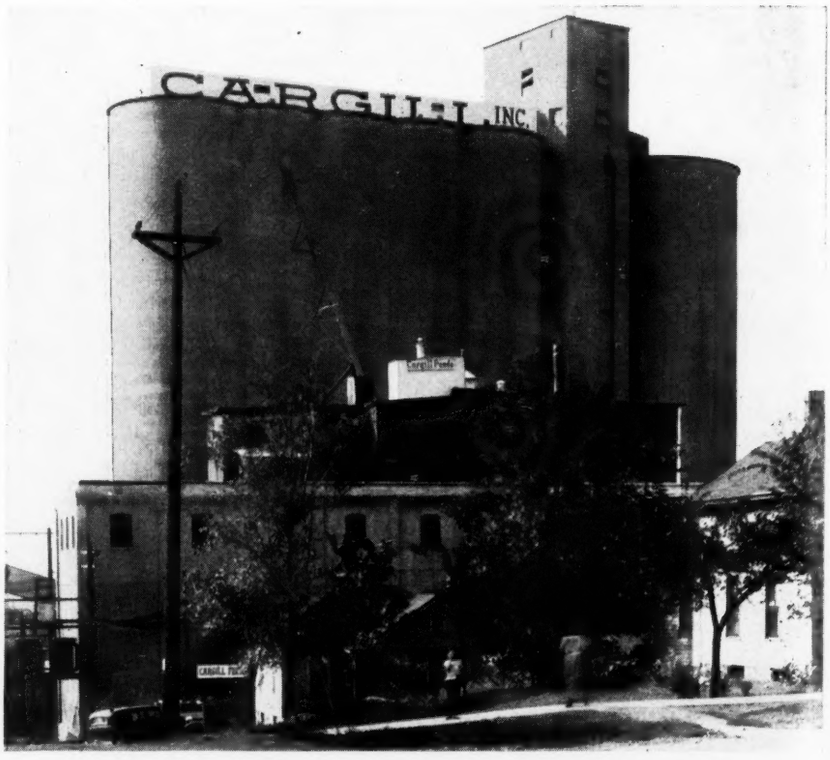
Pioneers often run into extreme difficulties. Pioneer processors were no exception, and all early ventures lost money. They had to learn the business from the ground up since nobody in America had had experience with soybean processing at that time.

Herman Meyer at Seattle, Wash., undertook the first known processing of soybeans in America. He crushed some Manchurian beans with a hydraulic press about 1911.

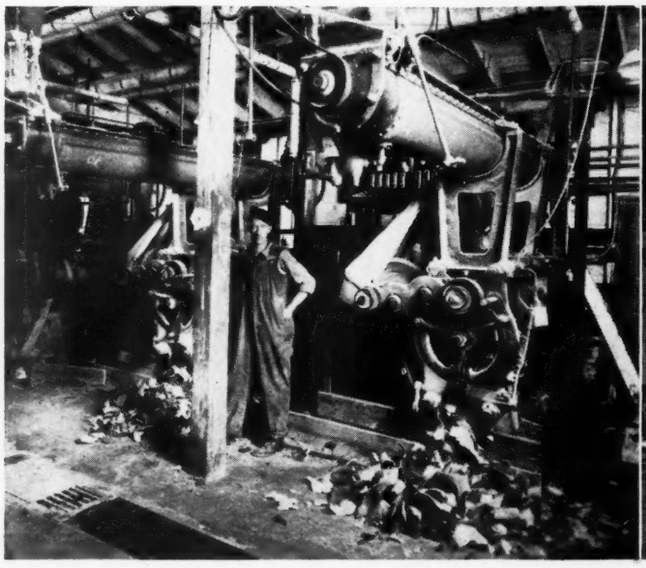
On the other side of the country, the Elizabeth City Oil & Fertilizer Co., at Elizabeth City, N. C., processed the first home grown soybeans. W. T. Culpeper, manager of the firm, conducted a test run on 10,000 bushels in December 1915, and was so satisfied with his results that he is said to have offered growers production contracts in advance in order to insure the company a supply of soybeans for continued operations. But in 1916 German interests took out of the country the entire local supply, paying up to $4.50 a bushel!

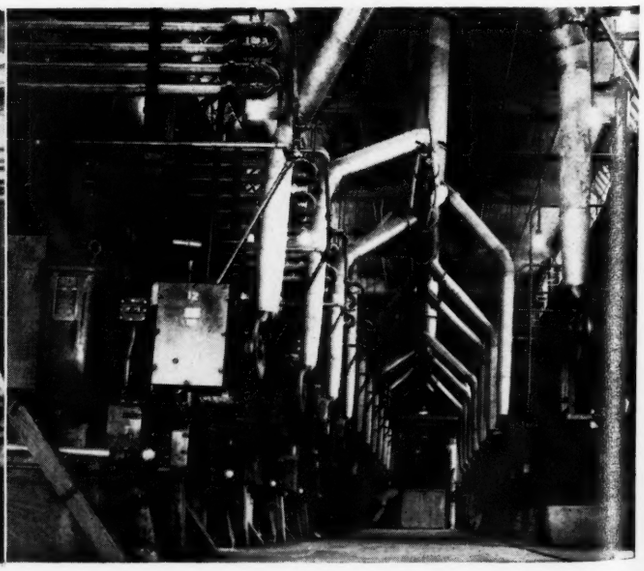
First Midwest processing was undertaken with expeller equipment designed for





Top right: the Elizabeth City Oil & Fertilizer Co., plant, first to process American grown soybeans. Right center: plant of Iowa Milling Co., pioneer processor west of the Mississippi. Lower left: expeller plant of A. E. Staley Mfg. Co., built in 1922. Lower right: modern plant built 20 years later.





crushing corn germ by the Chicago Heights Oil Manufacturing Co., at Chicago Heights, Ill., in 1917 or 1918. During the latter year the company added two expellers designed for soybeans. These were used sporadically until the equipment was sold to Funk Bros. Seed Co., another early processor of soybeans, in 1923. I. C. Bradley, now with Allied Mills, Inc., was in charge. He brought in beans from North Carolina, and crushed some of the first seed grown in Illinois. But he was unable to obtain enough beans to keep the plant in continuous operation.

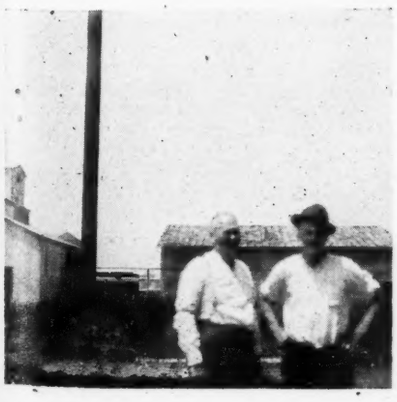
The enthusiasm and vision of the late A. E. Staley helped the infant industry over some of its first difficult hurdles. In 1922 "at the request of a large number of farmers in this community" he built an expeller plant with an operating capacity of 500 bushels daily at Decatur, Ill. Price paid was 99.75c a bushel. Mr. Staley wrote that operations were "unprofitable and very discouraging but it is our intention to leave the machinery in our plant for another year . . . " The A. E. Staley Mfg. Co. has been processing soybeans ever since.

An early solvent extraction venture was undertaken by the Eastern Cotton Oil Co., at Norfolk, Va. A Bollman type continuous extractor with 80 tons daily capacity was used on North Carolina soybeans. Again the supply proved inadequate.

So things hitched along. But in 1927 the "Peoria plan" was evolved when several processing companies contracted in advance with Illinois farmers to buy a cool million bushels of soybeans at $1.35. Wilfred Shaw of the American Milling Co., at Peoria, one of the contracting companies, said his company alone offered a potential outlet of 5 million bushels, and that the country as a whole should absorb upwards of 75 millions! The "Peoria plan" was an enormous factor in pushing Illinois to the front in soybean production.

First soybeans processed west of the Mississippi River were at Cedar Rapids, Iowa, by Iowa Milling Co., it is claimed. Joe Sinaiko and Max Albert, partners in the venture, installed the equipment consisting of two expellers, in the fall of 1927 and operations began the next spring. Albert later established the Galesburg Soy Products Co., while Sinaiko operated Iowa Milling until he sold to Cargill in 1943.

Part of plant of Eastern Cotton Oil Co., Norfolk, Va., early processor by solvent extraction method. At left is Mr. Schuenemann, erection engineer, at right, son of W. M. Gregory, principal stockholder. Immediately back of men is meal grinding house. Boiler plant is designated by the smokestack. Tall doghouse in rear locates Bollman extractor and solvent still. To left of field of vision is roll room, and still further left, seed storage.



—Champaign, Ill., News-Gazette.

Four soybean pioneers who attended the Silver Jubilee, three of them from Champaign County, Ill., the nation's leading soybean producing county. They are, from left to right: A. E. Burwash, Champaign; W. E. Riegel, Tolono; W. J. Morse, Bureau of Plant Industry, Washington, and J. T. Smith, Tolono.

Pioneers Recognized

Some pioneers whose work has contributed materially to the rise of the soybean in America were given recognition on behalf of the Association by J. C. Hackleman, University of Illinois extension agronomist, at the Tuesday evening meeting of the Silver Jubilee. They included:

TAYLOR FOUTS, Camden, Ind., first president of A. S. A. One of the most enthusiastic soybean producers and a farmer with vision was Taylor Fouts.

W. A. OSTRANDER, Lafayette, Ind., first secretary of the Association. Then the extension agronomist at Purdue University, he worked very closely with Fouts in preparing for the first meeting.

The late *CHAS. L. MEHARRY, Tolono, Ill.*, truly one of the pioneers of both Indiana and Illinois. He grew soybeans as early as 1908, and when he announced his intention of growing 19 acres in 1909, his farm manager, C. H. Oathout, asked, "What in the world are you going to do with that many acres of soybeans?" Mr. Meharry helped pioneer the combine for harvesting soybeans. He assisted with the work of the Association for years, acting as secretary and as a member of the board of directors. He was largely responsible for the design of the Association emblem.

MEHARRY

FRANK HURRELBRINK, Taylorville, Ill., farmer, began growing soybeans in 1904 and has grown them ever since. Obtaining seed from the University of Illinois, he set out to develop his own variety, seeking a bean that would stand well, would resist shattering and could be left in the corn field until the livestock could harvest the seed from the standing plants. This he did. The Hurrelbrink soybean is still grown and in demand.

DR. W. L. BURLISON, chief of the Agronomy Department of the University of Illinois, unable to attend the Jubilee because of illness although the program was largely of his planning. He has been actively interested in the crop since his association with the department. He led a coordinated study at Illinois in search of commercial outlets for soy products and had influence in obtaining a special federal laboratory for the study of the commercial uses of soybeans.

W. J. MORSE, U.S.D.A. Bureau of Plant Industry agronomist, dean of all soybean enthusiasts. The regional soybean laboratories are in no small part the result of his unceasing efforts.

G. I. CHRISTIE, former Purdue University agronomist and president of American Soybean Association. Now president of Ontario Agricultural College.

The late *F. S. WILKINS, Ames, Iowa*, leader of the soybean project at Iowa State College until his death in 1936. He picked the Mukden, most widely grown of Iowa's varieties, from the thousands of selections under his supervision. A most enthusiastic soybean scientist.

Silver Jubilee

AMERICAN SOYBEAN ASSOCIATION

WELL over 600 growers and others interested in soybeans from the most diverse standpoints, from 17 states, from Canada and even one soldier registrant from Iran called the Silver Jubilee meeting of the American Soybean Association at the University of Illinois, September 12-13 probably the most successful in the 25-year history of the Association.

EDUCATIONAL EXHIBITS

One of the most interesting features was the educational exhibits, probably the most extensive ever on display at an Association convention. The exhibits included soybean food, livestock feed, soybean industrial products, and a University of Illinois display. A display of farm machinery was inspected during the field trip at the Agronomy South farm.

There were many sincere expressions of regret that Dr. W. L. Burlison, head of the University's department of agronomy, who was in joint charge of program arrangements with retiring president, J. E. Johnson, was unable to be present since he was confined to his home recuperating from a severe heart attack suffered this summer. There was much expressed gratification at reports of his recent improvement. An enthusiastic audience beamed a loud round of applause to Dr. Burlison at his home over Radio Station WLS during the dinner bell program which was staged in the auditorium during the first day of the meetings.

Corporal George M. Strayer, editor of *The Soybean Digest*, and secretary of the American Soybean Association until he entered the armed services last February, when he was succeeded by Mrs. Strayer, obtained a week's leave of absence from the army and gave the joint secretary's report prepared by himself and his wife.

Howard L. Roach, Plainfield, Iowa, farm manager, was elected president to succeed J. E. Johnson, Champaign, Ill., popular retiring officer who declined renomination.

Walter McLaughlin, Decatur, Ill., was elected vice president. Jeanne M. Strayer, Hudson, Iowa, and J. B. Edmondson, Clayton, Ind., were reelected secretary and treasurer respectively.

Ersel Walley, Fort Wayne, Ind.; John Dries, Saukville, Wis.; Jacob Hartz, Stuttgart, Ark.; John Sand, Marcus, Iowa, and David G. Wing, Mechanicsburg, Ohio, were reelected directors.

New members to the board were Harry A. Plattner, Malta Bend, Mo., and Gilbert Smith, Taylorville, Ill.

On the nominations committee were G. H. Banks, Kansas City, Mo., chairman; G. G. McIlroy, Irwin, Ohio, and W. J. Morse, Washington, D. C.

The resolutions committee: Kellar Beeson, Lafayette, Ind., chairman; Jacob Hartz, Stuttgart, Ark., and David G. Wing, Mechanicsburg, Ohio.

Convention committees included:

Local committee on arrangements: W. L. Burlison, chairman; F. C. Bauer, Lita J. Bane, W. E. Carroll, E. W. Lehmann.

Subcommittee on industrial exhibits: N. P. Noble, chairman; K. J. Maltas, Lyman Peck.

Subcommittee on University exhibit: R. F. Fuelleman, chairman; M. D. Appleman, J. L. Cartter.

Subcommittee on field trip: G. H. Dungan, chairman: W. M. Bever, C. H. Farnham.

Report of the Secretary

1943-1944 Fiscal Year

This morning I will not attempt to give a detailed report on the operations of the American Soybean Association during the past year. Rather, I will touch on what to me are the more important subjects at hand. Your former secretary was inducted into military service in February, after serving the association for 5 months following the last convention. Since that time, and as a result of action taken by the board of directors in granting a military leave to me, Mrs. Strayer has served as secretary. This report necessarily is a joint report.

The 1943 crop of soybeans was of good to excellent quality and because of that the marketing program settled down in an orderly fashion, contrasted with the frozen beans and the many complications of the previous year. Large supplies of Midwestern soybeans were moved to southern mills for processing. This, also removed the meal from Midwestern markets and caused complications in the protein distribution. One thing against which the industry must guard in the marketing of the 1944 crop is the shipment of any sizeable quantity of Midwestern beans outside that area. Unless steps are taken to guard against outside shipment of 1944 crop beans protein supplies in the Midwest may become a still more serious problem in 1944-45.

The soybean processing industry has undergone the greatest expansion in capacity which has ever taken place in any one year of processing history. This capacity has been needed in order to process the current production of soybeans. However, there are many inherent dangers in such an expansion. Probably the greatest of these is the probability that we now have too many expeller or screw-press plants for peace-time needs. The adjustments to be made at the conclusion of wartime stimulation of acreage and processing may be rather severe on this type of plant. It is a thing which is becoming more apparent each day, and which will require the attentions of the entire industry in order that proper adjustments may be made.

FLOUR RULING

One year ago the ruling which had been promulgated by the Food and Drug Administration and which would have outlawed the use of soy flour in bakery goods, received much attention at the convention. As a result of the action taken there, together with the action taken by the board of directors and officers, assisted by other groups, the ruling was reversed to its former status. The usage of soy flour in bakery goods is again permitted on the same basis as previously.

Members of the legislative committee of the American Soybean Association have made two trips to Washington during the past year to represent us at hearings on the soy flour and the margarine bills. The soy flour situation was reported above, and as yet there is nothing definite to report on the margarine bill. We do believe that the association has achieved some measure of results and has built for itself a measure of influence and prestige in our capital city.

Financially the American Soybean Association is probably in the strongest position in its history.

One of the most pleasing factors has been the rate of renewals during the past year.

One of our bigger problems the past year has been that of paper supplies for *The Soybean Digest*. All publications have been required by wartime restrictions to reduce the quantity of paper consumed. This we have been able to do by reducing the weight of the paper used, by reducing the size of the sheet used, and by removing from our mailing list unpaid and complimentary subscriptions. When you stop to consider that the magazine has increased in size and that the number of paid subscribers has increased you can see the problem with which we have been faced. Your copy of *The Soybean Digest* may have seemed light and flimsy on occasion—it is necessarily so in order that we may comply with wartime restrictions. The September or convention issue which will reach you very shortly after these meetings will be the largest in our history—half again as big as last year's special edition.

During the year, at the authorization of your board of directors, the Association has purchased an Elliott addressing machine, complete with stencil cutter and the necessary stencil files. The mailing operation has thus been speeded up and at the same time costs reduced. You will note the increase in the inventory to cover this valuation.

Another decided improvement during the

year has been the moving to more satisfactory quarters of your secretary's office. This new arrangement and the added equipment have made for much greater efficiency of operation. You will see the results in months to come.

You will note that the net worth of the organization, as figured on September 1st, and on a conservative basis, was $5,483.81. This contrasts with a net worth of $1,825.67 on September 1, 1943. Frankly, those of us who have been working for the organization feel that we have made rather sizeable strides during the past year.

Another problem which we now face is that of competition from other crops. As an example, the peanut industry has drawn definite plans and has arranged for financing of a nationwide radio and newspaper advertising and publicity program. Other organizations and agencies will be taking similar steps and during the next few years the American Soybean Association must give serious consideration to a program for the industry.

While we have made remarkable strides during the past year in increasing the membership of the Association, the problem of adequate membership still is the largest one to confront this meeting. To truly represent the soybean growers of America we should have the major proportion of them among our membership. The most accurate figures which we have been able to obtain indicate a total of approximately 1 million farms in the U.S., on which 3 or more acres of soybeans are grown. On this basis you can see the field for expansion which lies ahead of us. If we are to be an effective organization we must continue to increase the membership to the point where we represent all growers of soybeans and thus can be truly influential in representing the industry in legislative and congressional halls. The 1944-45 year is one in which such plans might well be formulated and carried through.

Respectfully submitted,
Jeanne M. Strayer, *Secretary*.
George M. Strayer, *Secretary*.
AMERICAN SOYBEAN ASSOCIATION.

Resolutions

(1)

To our hosts for this splendid program for the Silver Anniversary of the American Soybean Association, this group through this resolution desires to express its deep appreciation to the staff of the University of Illinois and of the Federal Laboratory, to the various committees that have planned and executed their responsibilities so effectively, to industrial and research agencies that have arranged the splendid exhibit, and to the officers of the association. Especially does the association appreciate the enthusiastic leadership of President Joe Johnson, and his tireless efforts on behalf of soybeans; the outstanding abilities of Corporal and Mrs. George Strayer and the successful efforts of both to publish and improve the *Digest* under wartime difficulties that would entirely discourage less capable and persistent personalities; and the steady work of Kent Pellett as managing editor of the *Digest*. To Dr. Burlison, the Association expressed its gratitude for the best part of a life-time given to the promotion of soybeans, and the sincere hope for a speedy recovery. Regret is expressed unanimously by the membership that Dr. Burlison has not been able to be present at this celebration, but his guiding hand and spirit have been evident in the execution of this memorable program. To Roy Monier, always present for the annual meeting and boosting the soybean . . . the association also sends greetings and the hope for an early recovery.

(2)

The Association reiterates its approval of recently adopted resolutions and expresses its appreciation of the successful efforts of Howard Roach and David Wing who in Washington conference aided in delaying the enforcements of any restrictive rulings on soybean flour until a postwar period by which time it is felt that the merit and place of this flour will have been well established and its worth proven.

(3)

Whereas bleaching of soybean oil destroys its natural yellow color, and is reported to destroy part of its carotene content, be it resolved that the Association go on record as favoring the repeal of such laws as require the bleaching of this oil before being used in margarine. Be it further resolved that the Association reaffirm its former stand favoring the repeal of discriminating taxes imposed on margarine made from domestically produced fats and oils.

(4)

Whereas satisfactory use has been made of soybean oil in paints and varnishes and whereas this use is the most extensive one outside the edible field, be it resolved that the Association urge that every possible action be taken to point out the merit of soybean oil in paints and varnishes and the importance of its extensive use in the postwar period.

(5)

Whereas other products are being developed to supplement the present uses of both soybean oil and meal, be it resolved that the

(Continued on page 65)

OPENING THE CONFERENCE

By J. E. JOHNSON
President American Soybean Association

SOME OF the great personalities of the past—men who helped to build this industry—have long since left our midst, but the shadow of their fine work remains.

It is too bad that such men, all pioneers in what is now a new industry of mammoth size, could not have lived to see the present fruits of their early efforts. I have in mind some of the early research workers, agronomists and chemists, some of the courageous growers who never swerved from their course, and some of the early processors who found markets for the products of the soybean. Observance of our 25th milestone is recognition of their work and of the substantial achievements of the industry to date.

Much has happened in the span of a quarter of a century which marks the life of this Association. The momentum of the early efforts began gaining speed a decade ago, and while the war has brought the sensational expansion, we had nevertheless attained the size of a large industry before the war broke out. We hope to retain our place in agriculture. We, the growers, believe this can be done.

It is fitting indeed that the twenty-fifth Jubilee of the American Soybean Association should be held at Urbana. In all these years the faith of the great soybean leaders at this University has never flagged. They charted a straight course and have helped to guide the growers steadily down that course. They have helped to make Illinois a great center of production, a state which up to the past few years produced half of the crop in the entire country.

Much of the success of the American Soybean Association would not have reached its present proportion save for the combined efforts of the good friends of the grower right here at Urbana and those of the other Midwest states. Illinois takes this opportunity to express its sincere appreciation to individuals, groups and agencies with whom she has worked in making possible the growth of the soy-

A field trip featured the first afternoon of the Silver Jubilee. At left, Deane G. Carter addresses a group on the cooperative storage project. Right, a crowd inspects one of the University's soybean test plots.

bean industry as we see it today on the 25th birthday of the American Soybean Association. Obviously no crop in America has meant as much as the soybean in a quarter of a century.

It is gratifying, in opening this conference, to report that the membership of your Association now extends to all growing states and to most growing areas. Interest in the activities of your Association is steadily on the rise. Your monthly magazine, *The Soybean Digest*, has attained a permanent place in the publication field and will continue to grow in prestige by reason of its faithful adherence to fact, its independence of expression and its wealth of informative material now available to all branches of the industry.

At a meeting of this kind, packed as it is with able speakers, with stories of intense interest to be told, I shall not dwell upon the past despite the temptation to review many fascinating events and developments. This meeting looks to the future. History and economic developments move with exceptional speed and require foresight and planning rather than retrospection.

It is my confident belief that out of this twenty-fifth Jubilee, out of the studies prepared for submission to this conference, will come an inspired confidence that will help us to meet the challenges and opportunities of the future.

WHAT IS THE U. S. REGIONAL SOYBEAN LABORATORY DOING?

By J. L. CARTTER

• *Report of the work of the last 8 years of this Laboratory, which is a cooperative organization participated in by the Bureau of Plant Industry, Soils and Agricultural Engineering, U. S. Department of Agriculture, and the agricultural experiment stations of Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, Wisconsin, Alabama, Arkansas, Florida, Georgia, Louisiana, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, and Virginia. The author is senior agronomist of the Laboratory at Urbana.*

IF I were to sum up the work of the Laboratory in one sentence I would say that we are developing improved varieties and strains of soybeans for industrial use. One of the most essential factors in the economical growing of any crop is an adequate supply of adapted productive strains. The soybean crop is no exception to this rule, making a program of varietal improvement of great importance.

It was not until 1889 that work on this crop was reported by any experiment station. In that year, W. P. Brooks of the Massachusetts Agricultural Experiment Station brought with him several varieties from Japan and the next year C. C. Georgeson of Kansas secured three introductions from the same country. In 1898 the U. S. Department of Agriculture began the introduction of a large number of soybean varieties from all over the Orient. Since that time around 15,000 introductions have been made by the Department and the majority of the present commercial soybean varieties have come from these introductions as a result of improvement through selection.

THIRTY YEARS

Breeding and selection work to develop improved strains of soybeans with respect to yield and other agronomic characters has been carried on by experiment stations for the last 2 or 3 decades. The high protein and oil content of the seed and the need of these constituents for food and feed has made necessary a large-scale breeding program to meet the demand for improved varieties.

The U. S. Regional Soybean Laboratory was started in the spring of 1936 as a Bankhead-Jones project, and headquarters were established at the University of Illinois, where adequate laboratory, greenhouse, and office facilities have been provided by the University. With this inauguration of the Laboratory as a cooperative undertaking by the U. S. Department of Agriculture and the 12 states of the North Central Region, a more extensive breeding program became possible, using chemical analysis of strains as a further basis for selection.

Several thousand soybean plant introductions and selections being grown at the cooperating state experiment stations have been studied for agronomic behavior—such as yield, lodging resistance, shattering resistance, height, seed quality, etc.—and the seed analyzed chemically to determine the best strains for industrial use. Much of our effort during the first few years of the laboratory was devoted to improving the technique of testing strains and in learning the effect of such factors as date and rate of planting, soil type and fertility level of the soil, fertilizer applications, time of trimming the ends of the plots, effect of adjacent varieties of different maturity and many other factors on the accuracy of the soybean yield testing work. All this was a necessary preliminary to any large scale testing of new strains.

In 1938 a system of uniform soybean variety and strain tests was started in the North Central States. In these first tests about 20 or 30 improved strains were grown along with a few of the best commercial varieties. These uniform tests were grown at several locations in each of the cooperating states and seed samples were sent to the analytical section of the Laboratory for chemical analysis. During the first years of this work only three groups of strains were grown and were designated as the early, midseason and late tests. It was soon found that this designation of the tests was inadequate, especially as the area served by the Laboratory increased.

When speaking of soybean varieties, the terms early, midseason, and late must always be thought of with reference to some small area or zone of latitude under consideration. As an example of this, the variety Macoupin which is considered as a late variety for Illinois is a very early variety for Mississippi conditions. We are now endeavoring to express the maturity rating of a new strain in relation to some standard adapted variety with which we are all familiar. Thus we are using the variety Illini as the reference strain for the group adapted to Central Illinois, and can express maturity of the other selections in the nursery as so many days earlier or later than Illini.

The number of uniform nursery groups in the North Central States was increased to four in 1942. In July of that year the part of the Laboratory work devoted to the development of new industrial uses for soybeans was transferred to the Northern Regional Research Laboratory at Peoria, Ill., and at the same time the area served by the U. S. Regional Soybean Laboratory at Urbana was enlarged to include 12 of the southern states as well as the original 12 states of the North Central Region.

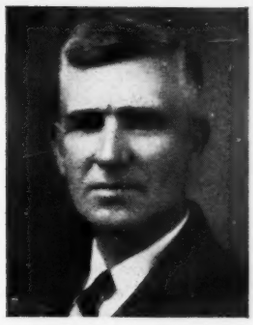
To adequately serve the breeding program of the greatly expanded laboratory region a total of eight uniform nursery groups have been arranged for 1944, including strains early enough for Minnesota and late enough for the Gulf Coast states. Of these nurseries, the Uniform Test, Group O, is composed of very early strains suitable for the northern part of the North Central Region. Group I is made up of slightly later material, suited to the latitude of central Wisconsin and southern Minnesota. Group II is composed of strains of a proper maturity for the latitude of northern Illinois and central Iowa. Group III is adapted to central Illinois and Group IV to southern Illinois and Missouri. Groups V, VI, and VII composed of progressively later soybean strains are adapted to the Southern States. These uniform nurseries furnish a means of accurate and rapid determination of the value of any new strains developed through the breeding work.

Definite progress has been made in the breeding and testing of new soybean strains. Certain strains have been found especially suited to certain specific conditions of environment. One of these strains, Richland, selected by the Indiana Agricultural Experiment Station from a U. S. Department of Agriculture plant introduction is particularly adapted to soils of high productivity due to its short habit of growth and lodging resistance. On the other hand, Earlyana, developed by the Indiana station and widely tested by the Laboratory is 4 or 5 days earlier than Richland and on account of its earliness and tall growth habit is especially adapted to the less fertile soils of the northern part of the soybean belt.

One of the most important achievements of the cooperative work has been the development of the variety Lincoln. This strain is from a natural cross discovered by the Illinois Agricultural Experiment Station in 1934 and selected by the Laboratory on the basis of outstanding yield and oil content of

(Continued on page 62)

Twenty-Five Years of
SOYBEAN GROWING IN AMERICA



By W. E. RIEGEL

● *An account of the past quarter century by one of Illinois' old time soybean growers. The author was a close associate of the late Charles Meharry. Together they pioneered in soybeans and lespedeza. He is farm manager of the Meharry land in Champaign County. A graduate of the University of Illinois, he served on the agronomy advisory committee and the general advisory committee of the University for many years. He is a former president of the American Soybean Association.*

OUR EARLIER producers knew little about the soybean and had the handicap of inadequate planting and harvesting equipment, and compared to the present, used very mediocre seed. Fortunately for the future of the soybean, the United States had men of vision with the spirit of pioneers. Prominent among the earlier growers in the Midwest states who began to study and visualize the possible future of this new crop as early as 1890 in Illinois was J. C. Utter of Wabash County, later followed by Frank Hurrelbrink of Christian County, C. A. Rowe of Morgan County, Ralph Allen of Tazewell County, C. L. Meharry, John T. Smith, C. H. Oathout and W. E. Riegel of Champaign County. In Indiana were the Fouts Brothers of Carroll County, J. B. Edmondson of Hendricks County, Frank Goodwine of Warren County and in Ohio were Glen G. McIlroy of Union County and Leonard Hill of Miama County. In Iowa, Bert Strayer, William McArthur, John Sand and J. W. Horlacher were some of the earlier growers. Many other states like Wisconsin, Missouri and the Carolinas had their earlier growers and champions.

At this same time our experiment stations located in the Midwestern states were studying the soybean and making tests of new varieties. As early as 1915 demonstration projects were set up in different counties in the various states for the purpose of acquainting farmers with the new soybean crop and its culture.

These demonstrations and meetings were of great importance, because during the years, thousands of people, skeptical and otherwise, attended and there they saw different varieties growing side by side, also the effect of different soil types and the growth under different conditions.

EARLY PROCESSORS

The value of such field demonstrations may be illustrated by referring to some of Illinois' early progress. First in 1920, Illinois had three demonstrations in the state and in 1925, 28 counties had demonstration plots. This brought the soybean work to the very front door of many farmers.

Second in 1922, approximately 50 bushels of a pure selection of Manchu soybeans were introduced into the state from A. A. Evans, West Branch, Mich., and certification of that seed started. A soybean survey made at the end of 1927 indicated that the Manchu occupied between 65 to 70 percent of the commercial soybean-producing area in Illinois.

Third, "the rapidity with which farmers have changed to new and better varieties of a crop is illustrated in the swing from Manchu to Illini. As previously stated, the Manchu occupied approximately two-thirds of the commercial bean acreage in 1927. Illini was introduced into the (demonstration) plots in 1924 and was released for increase in 1926. A survey made in the fall of 1930 showed the Illini on three-fourths of the commercial acreage." The foregoing is not at all peculiar to Illinois but only an example of what was being done by experiment stations and the agricultural extension service in many of our states.

A very definite "bottle neck" began to show up in the soybean production in the early 20's, because of the lack of proper harvesting equipment. The small grain harvesting and threshing machinery was not at all adequate and satisfactory. Due to the fact that the soybeans were not ready to harvest until late fall, the soybean grower encountered many difficulties, such as fall rains, mud, competing with corn harvest, etc.

As early as 1920, at a large soybean meeting held on the Fouts Brothers farm at Camden, Ind., Taylor Fouts showed us a small direct harvesting machine for soybeans. I am sure that the most optimistic persons attending this meeting did not realize that the combine harvester would become prominent in harvesting soybeans so quickly.

In the fall of 1924 Garwood Brothers used the first combine in the state of Illinois to harvest soybeans. Fortunately the first combines which came into the soybean fields did a good enough job to prove that they had a future in soybean harvesting, but they were far from being perfect. Consequently for several years, many of the combine builders spent days and weeks with their respective machines in the soybean fields. From 1926 to about 1930 it was no uncommon sight to see a carload of men, including president, vice-president, chief engineer and the best mechanics the company had drive into the soybean field and spend plenty of time, not only studying to improve their own machine but not missing an opportunity to see what improvement the other manufacturers had made. The agricultural engineers of our various colleges made a very definite contribution in helping improve the combine. As an example, during those earlier years Mr. Blauser and Mr. Young of our own Agricultural Engineering Department spent many days in the fields behind the combine gleaning the straw and stubble for wasted soybeans.

Another stalemate in the development of the soybean industry seemed unavoidable previous to the establishing of a commercial market for the surplus beans. The earlier popularity and demand for seed kept pace with production for a few years but in the early 20's many of the producers began to see the day when the demand for seed beans would not be equal to the crop harvested. Efforts to find a commercial processor willing to help pioneer a new industry made relatively slow progress. The processor immediately found it difficult to interest manufacturers of mixed-feeds in soybean products. They were reluctant to attempt to add soybean oil meal to their formulas because there was no assurance of being able to get the needed amount each year. The producer, at the same time, was thinking about reducing his acreage of soybeans because he feared there would not be a market outlet for his beans. This rather uncertain production program came to a climax in 1928.

PEORIA PLAN

As a result of suggestions made in the winter of 1927-28, H. G. Atwood, president, and Arthur G. Heidrick, vice president, of Allied Mills offered to discuss the possibilities of working out a marketing plan for the increased output of soybeans. At a conference attended by Messrs. Atwood, Heidrick, James McConnell of G. L. F. Farms, Farm Adviser Wilfred Shaw and J. C. Hackleman, a plan was formulated for underwriting the production of 50,000 acres of soybeans. Press and radio helped acquaint producers with the program. The following comments from the April 21, 1928 issue of *Prairie Farmer* are typical:

"For the first time in history, except during the war, Illinois farmers have the opportunity this year of planting a major crop in the spring with the certainty that they will get a specified price for it when it is ready for market in the fall."

"The American Milling Company of Peoria, the G. L. F. Exchange of New York which operates a large mill at Peoria, and Funk Brothers Seed Company of Bloomington, have offered to enter into an agreement with Illinois farmers to buy 1,000,000 bushels of soybeans from this year's crop, at a guaranteed minimum price of $1.35 a bushel for No. 2 beans, F. O. B. Bloomington or Peoria. The price for No. 1 beans will be one cent a bushel higher; for No. 3 beans, two cents a bushel lower; and for No. 4 beans, four cents a bushel lower."

This guaranteed price for soybeans did not stop in 1928 but was renewed in 1929 not only with Illinois but was also offered

to Indiana and Ohio. This was surely the turning point in soybean history.

In the winter of 1928-29 a small group of members of the American Soybean Association, Walter Godchaux of Louisiana, C. L. Meharry of Indiana, John T. Smith and W. E. Riegel of Illinois went to Washington in the interest of tariff protection on soybeans, soybean oil and soybean oil meal. Until 1930 soybean producers had very little protection on beans and oil and none on the meal.

With the increased demand for soybean products in the United States, many people felt that our soybean farmers should not and could not compete with the Orient in producing cheap soybeans. As the result of the committee's week in Washington, we now enjoy the protection of the tariff passed June 18, 1930, of $1.20 per bushel on soybeans, 3½ cents per pound on soy oil and $6.00 per ton on soy oil meal.

SOAP MEN OPPOSED

The chief opposition encountered in Washington was from the soap manufacturers who wished to keep the tariff on soybeans, oil and meal very low.

The processing of soybeans is a big story and a very important one. The promise made by the National Soybean Processors Association several years ago, "You grow the beans and we'll find the market," has been very ably kept. However, prior to the time when the processors made the above promise a great deal of experimental work had been done. This meant pioneering not only in processing but also in marketing the products.

One of the first men in this field was our good friend, I. C. Bradley of Taylorville, Ill. He discovered that some cotton oil mills in the south had processed a few small lots of beans left over from seed which had been grown in the Carolinas and Virginia. In the language of Mr. Bradley, "At this time there was a small flaxseed crushing plant equipped with both hydraulic and expeller pressers located at Chicago Heights, Ill., which being close to Illinois-Indiana boundary line and both states rather predominating in their interest in soybeans could conveniently serve both. As it was soon after World War No. 1, "It was all dressed up and no place to go" and glad to help solve the problem of surplus soybeans, and it was so arranged."

"The simple information that a processing plant was giving its entire energy to soybeans caused so much interest in planting soybeans that the seed demand took all the beans with, no surplus left for processing and it became necessary to ship a few cars from North Carolina in order to get experimental mill work, from which was recovered the first tank car of domestic soybean oil sold on the Chicago market and was the very beginning of a calculated study of procedure of domestic processing of soybeans." Therefore, it is seen that much time and careful thought was given to developing the processing of soybeans.

Today there are in the United States numerous plants with a total capacity capable of processing 150 million bushels of soybeans annually.

The U. S. Department of Agriculture, after studying various phases of the soybean industry, announced standards in September 1925, and recommended their use in the grading and marketing of this commodity. Slight revisions were made on soybean standards effective September 1, 1926. One change included a super grade to take care of extra high grade stock, such as the seed trade demands. Wholesale seedsmen usually purchase their supplies on the basis of the two high grades. A futures market for soybeans was established in Chicago in October, 1936.

The Bankhead-Jones Act passed in June 1935 stated as one of its purposes "the Secretary of Agriculture is authorized and directed to conduct research relating to the improvement of the quality of, and development of new and improved methods of production of, distribution of, and new and extended uses and markets for, agricultural commodities and by-products and manufactures thereof." As a result of this act we have the U. S. Regional Soybean Industrial Products Laboratory in Illinois. To put it in Director O. E. May's words, "the broad objectives of the laboratory are to ascertain the effects of varietal and cultural differences on the chemical composition of the soybean and to develop new industrial outlets and improve present industrial uses for soybeans and soybean products."

Soybean products have gone into many channels of our national life. They are being used in considerable quantities in human food in the United States. Great amounts are used in livestock and poultry feed. There is a great field in plastics and building materials hardly touched yet. In the early 1930's experimental work was done to find out how to use soybean oil in paint. The work at Illinois was conducted by Dr. W. L. Burlison. This work led to the utilization of large amounts of soy oil by several large paint manufacturers. Many of the farm organizations have adopted formulas and are now using thousands of gallons of soybean oil paint.

The American soybean producers will never know how important their earlier pioneering became in the production of food, oils and supplies which have gone to our fighting forces, and our allies, and to a great measure have helped in the winning of the war. The soybean has made good.

SOYBEAN INSECTS

By J. H. BIGGER

● *Losses due to insects are continually assuming greater importance. Among current menaces are grasshoppers, fall webworm, grape colaspis and Japanese beetle. Mr. Bigger has worked for the Illinois Natural History Survey since 1922, first as field entomologist, then associate entomologist.*

WE CAN no longer boast that soybeans are an insect-free crop, as we did a comparatively few years ago. It is still true that the crop suffers relatively small damage as we survey the nationwide situation, but losses due to insect attack are creeping in and gradually becoming of greater importance. We may expect this trend to continue and are watching developments with a wary eye.

In Illinois, during the past month, we have witnessed the ability of grasshoppers to cause spectacular damage to soybeans. Particularly in the western and southwestern parts of the state, grasshoppers have caused damage that will result in the loss of many thousands of bushels in the soybean crop of 1944. This damage started in the middle of July and is still going on to some extent. Probably 40-50 tons of grasshopper bait have been used in a few counties in an attempt to reduce the damage to soybeans, and with very considerable success, but, in spite of this, losses are going to run into important figures. Most of these losses could have been prevented if timely warnings had been heeded, and control operations had been carried on in the early stages of the outbreak.

During the past 2 years there has been an attack against soybeans from an entirely unexpected quarter. The fall webworm, *Hyphantria cunia* (Drury) has attacked soybeans in a number of cases. Each of these attacks has occurred when the larvae, after stripping adjoining hedgerows, migrated into the soybean fields. It has been found possible to stop this damage by applying a poison dust to the plants. One farmer, lacking other equipment, applied the poison by running it out of the fertilizer attachments on his planter.

Another present pest of soybeans is the grape colaspis, *Colaspis brunnea* (F.). This insect is both a direct menace to soybeans and an indirect threat to corn crops following soybeans on the land. The insect usually requires more than 1 year to build up a menacing population, but if soybeans are grown on the same field for several years in succession, trouble may be expected, at least in the Midwest. The damage may also occur if the soybeans are grown on land that grew any other legume the previous year. Damage results from feeding on the roots of the plants by larvae of the insect and damaged plants are usually killed. As far as soybeans are concerned, most of this damage may be avoided by frequent rotation of crops in the fields.

Our soybean crop is threatened by the approach of the Japanese beetle, *Papillia japonica* Newm. Up to date this pest has not caused any trouble in the Midwest, but it is a potential pest of real consequence. We are looking into possible control measures in an effort to be prepared if trouble develops.

As the soybean growing industry ages we will undoubtedly have other insect pests to cope with, but we are on guard and hope to be able to meet them successfully when the occasion arises.

CONTRIBUTIONS of MACHINERY and POWER to SOYBEAN PRODUCTION

By E. W. LEHMANN and H. W. BATEMAN

E. W. LEHMANN

AS NEW CROPS develop or as old ones are introduced into new areas, there are many factors which determine their adoption by farmers in their production program. The ability to secure seed and its cost may be a stumbling block. The labor required in production and the need of new machinery or the adaptation of existing machines are often limiting factors. The success of a crop may be dependent on the development of a single machine. Harvesting the soybean crop 25 years ago with the harvesting machines then available was found to be a major problem wherever soybeans were grown for grain. The combine, when finally used in 1924, proved to be a solution to the soybean harvesting problem. Other machines have been developed during the past 25 years which have contributed to the production of this crop.

Since this 25th annual meeting of the American Soybean Association has some significance from a historical point of view, a brief report, particularly of the combine's contribution to the advancement of the soybean crop, seems quite appropriate. Most Illinois farmers used the grain harvesting equipment they had at hand.

SPECIAL HARVESTER

A special soybean harvester, of the beater type, was developed in Virginia and was used to some extent in other southern states. Such a harvester was secured by the Department of Agricultural Engineering in 1923 for test purposes in Illinois. This beater machine was not successful for harvesting due to the high losses. Other harvesting machines tested before the combine came on the scene were: the self-rake reaper and thresher; the mower, rake and thresher; and the binder and thresher. Tests on these various methods indicated the average losses approximated 30 percent, with individual losses as high as 45 percent. The threshing machine was made to do a good job of threshing beans simply by changing the speed of the cylinder. The problem to be solved was to reduce the large percent of the losses that resulted from the several operations before the beans reached the threshing mechanism. Practically all of these losses, except those at the cutter bar, were found to be saved when the combine was used.

In 1923 a conference was arranged with representatives of three of the large manufacturing companies, and they were requested to loan a combine to the University for testing its possibilities for harvesting soybeans. The idea of using a combine, then available in large sizes in the West, on the smaller farms east of the Mississippi River where grain had always been shocked and later threshed was considered by them as a "wild-eyed dream," and their decision was unfavorable.

● *The development of suitable machinery has contributed to more efficiency, higher yields and lower labor costs. Use of the combine alone has added 4.6 bushels per acre to the average Illinois soybean crop. Professor Lehmann as head of the Department of Agricultural Engineering since 1921, has pioneered in the adaptation of power driven machinery to soybean production. Mr. Bateman, associate in agricultural engineering, has been a member of the staff of the department since 1936.*

Through the interest of C. A. Dennison, branch manager of the Massey-Harris Co., of St. Louis, a machine from Canada was secured which was sold in 1924 to Garwood Bros. of Stonington, Ill. According to the best information we have, this was the first combine that was ever used any place for harvesting soybeans. In 1925 Mr. Denison sold 11 additional combines in Illinois. In June of that year, at the request of Mr. Denison, I surveyed the possibilities of using combines in Mississippi, and he sold several machines in that state that year. By 1926 other manufacturers of combines had recognized their error and realized that the combine apparently was the solution to the soybean harvesting problem. A total of 52 machines of various makes were sold in Illinois during 1926, making a total of 64 machines available.

Most of the early combines were purchased for harvesting soybeans, although many other crops were successfully harvested with these machines. The soybean acreage made up 53 percent of the 11,105 acres of all crops harvested by 52 of the 64 machines being used in Illinois in 1926. The average losses incurred in harvesting with the combine were less than one-third the amount lost with the other methods, which proved the combine to be the machine for harvesting soybeans. However, it is evident that since the cutter bar loss is still fairly high, a great need exists for the development of a variety of soybeans which produces all the pods higher up on the stalk and which will not shatter and lodge as badly as do existing varieties.

WAS MOST CONVINCING

The higher quality, in addition to lower losses, of beans harvested with the combine was also most convincing as to the value of the combine in harvesting soybeans. During 1925 and again in 1926, when the soybean harvesting seasons were exceptionally wet, tests indicated the higher quality of combined beans since they were not only of lower moisture content but also the germination of the combined beans was much higher than of those harvested by other methods. A difference of 10.1 percent moisture content was found in beans harvested the same day in adjacent fields, one lot with the combine and the other with a threshing machine. The beans threshed from the shock had 24.6 percent moisture content while those harvested with the combine contained a moisture content of only 14.5 percent. It is easy to understand that standing beans dry much more rapidly following a wet period than shocked beans. Consequently many of the shocked soybeans were of a poor quality when threshed.

Results showing the higher germination of combined beans as compared to the germination of beans harvested by various other methods were reported by the Illinois Crop Improvement Association. In 1925 only 6 out of 90 lots of soybeans submitted for certification passed the germination test. It is of particular interest that of these six, five were harvested with the combine, as compared to one of 84 lots harvested by other methods.

RAPID INCREASE

Before the combine was used to harvest soybeans, approximately 50 percent of the relatively small acreage of beans produced was grown for hay. To a large extent, those farmers who grew beans for grain expected to sell them for seed. Following the advent of the combine as a means of harvesting beans for grain, the acreage of soybeans has increased very rapidly.

There have been changes in the combine design, but in principal it is essentially the same as the combine which was introduced from the west 20 years ago. Three types of combines were used in 1926: the motor-mounted type which was drawn by a tractor, the power take off type, and a combine mounted on a tractor and driven from the belt pulley. The latter was one of the first models of the self-propelled types which has been developed to a more successful machine and put on the market in limited numbers by a few companies this season.

The first small combines, that is the 5- and 6-foot cut, came into the picture in 1935, and the 3½- and 4-foot machines were available in 1939. These small combines were of the power take off type and were designed so that they could be operated successfully with the tractors available on most farms. Since the investment required for these small machines was low, farmers with small acreages of beans were justified in purchasing them. Having a combine gave these farmers more assurance of getting their beans harvested in time than to depend on a custom operator. The increased sales of small combines has been in proportion to the increase in the

soybean acreage since 1935 and no doubt the availability of these combines has played a considerable part in making possible the rapid increase in the soybean acreage for grain. At present, 80 percent of the combines in the Cornbelt are of the 6-foot size.

The reason for the increase in the use of the small combine is indicated by the fact that 75 percent of the farms in Champaign County, the leading soybean producing county in the United States, grow 84 acres or less. The small combine, however, has a capacity to harvest more than this acreage in a season and is available to do custom work on other farms in many cases. It has been possible, therefore, to harvest the great increase in soybean acreage even with the large portion of small combines being used.

In recent years further contribution in labor reduction has been made through the improved design of the 8- and 9-foot machines so they may be operated successfully by one man. The self-propelled machine, which is now receiving considerable attention, has the distinct advantages of saving labor, making it easy to open a field, and saving more grain in opening a field. Its inherent high cost seems to make it justified where large acreages can be harvested on a farm or through custom harvesting.

It should be emphasized that the present type of tractor, mounted on rubber with power take off, has made the use of planters, cultivators, and combines more effective and has helped to reduce the peak labor periods in planting and harvesting both soybeans and corn, which compete for labor during the planting and harvest seasons. Power and machines have further contributed to the solution of the problems in soybean production by making it possible to get the seedbed prepared more promptly than formerly and to have the crop planted more nearly at the correct time. Due to the large demand for labor and power during the planting season and because of the general practice of planting corn first, soybean planting is unduly delayed on some farms. Indirectly, therefore, having adequate equipment, both for corn and beans, contributes to timely planting and harvesting of the soybean crop.

IMPROVED PRACTICES

Farmers have improved their practices in using machines to prepare a good seedbed which meets the requirements of the soybean plant. In general, they start preparing the seedbed for soybeans early, permitting the weeds to start growing; and by one or more discings, several crops of weeds may be destroyed before the soybeans are planted, thereby reducing the number to be killed by cultivation. By having the seedbed in good tilth with sufficient moisture, the soybean seeds germinate quickly and grow rapidly so a serious weed problem does not develop. Normally the weeds which appear after planting can be controlled by means of the rotary hoe and other available cultivating equipment depending on whether the beans are drilled solid or are in rows.

While most farmers use existing tillage equipment to prepare a good seedbed for soybeans, some use the "culti-mulcher" or "soil fitter," a new tillage machine which is proving to be very effective, for preparing a seedbed for either soybeans or corn.

No great problem developed in planting soybeans since the grain drill was adapted for drilling the beans solid, and it is being successfully used for planting in rows, simply by closing a certain number of holes. Manufacturers have made minor changes in the design of grain drills to further improve them for planting soybeans. Due to a greater weed problem in soybeans that has resulted from ineffective weed control in solid-drilled beans, a larger percent are now being planted in rows so that they can be cultivated. The grain drill is used to plant either 21-, 24-, 28-, or 32-inch rows depending on the spacing of the drill furrow openers and on the width of rows desired. The 24- and 28-inch rows are the most desirable widths since they are wide enough to be cultivated without injuring the plants with the tractor wheels. Beans planted in rows of these widths completely shade the ground in a shorter period of time than wider rows and thereby retard weed growth.

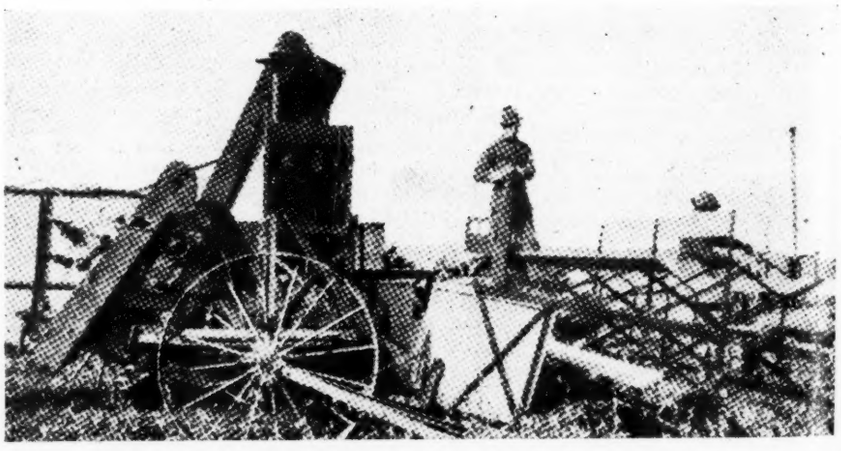
The corn planter is used successfully to plant beans in 36- to 42-inch rows which permit easy cultivation and weed control; however, the beans do not completely shade the spaces between the rows to help prevent weed growth as quickly as beans in narrower rows. The tendency of higher ridges resulting in cultivating these wide rows causes, in some cases, greater harvesting losses. The bushy beans that frequently develop in wide rows also result in some harvesting difficulties. A further disadvantage that has been reported is that wide rows usually give a significantly lower yield than solid planting or narrower rows.

Soybean planters have been developed by manufacturers to plant beans in rows. These implements have a place where a suitable grain drill is not available. Row spacing is not the only problem in connection with the planting of soybeans. The implement used for planting makes a contribution in bringing about conditions which will result in uniform germination of the seeds which are planted. Specially designed planters and drills aid in this connection. Since soybean seed is expensive, the use of the best equipment to plant the correct amount at the most optimum width and depth is an essential factor in economy in the use of seed to obtain the highest yield. An important improvement manufacturers have made is special furrow openers for drills and corn planters, which make it possible for the seed to be planted in moist soil and to make better use of the moisture available so that the beans will germinate and grow rapidly. Using special furrow openers makes it difficult to break the heavy crust that sometimes forms before the beans come up.

INEXCUSABLE PRACTICE

Another practice which seems inexcusable is that of not cleaning the soybean seed before planting it. Some farmers through carelessness plant soybeans with buttonweed and other weed seeds mixed with them because the beans were not properly cleaned. For effective weed control, harrows are used 2 to 3 days after planting, and, in fact, have been used when the beans have reached a height of 6 to 8 inches, although there is danger of damaging beans at this height. The higher speeds available when the tractor is used make the rotary hoe an effective cultivating machine; and it is used not only for weed control, but also for helping beans break through the crust that is sometimes formed after planting as a result of heavy rains.

To reduce the cost and the time for changing to the soybean cultivating equipment, special cultivator bars have been made available for certain tractor models at little expense. A special combination corn and bean cultivator has been developed, at least by one manufacturer, which will reduce the investment in both planting and cultivating equipment for corn and soybeans. To avoid ridging, special culti-



First Soybean Combining

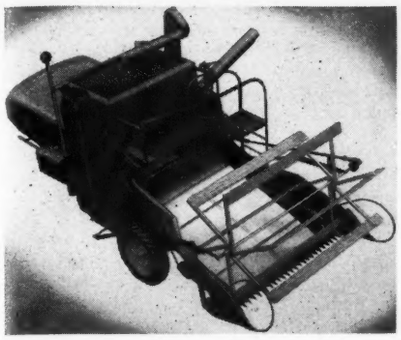
By the fall of 1923 the four Garwood brothers, Frank, Harry, Herman and William, who were extensive soybean producers at Stonington, Ill., had decided that they must find a new method of harvesting if they were to continue to expand acreage. It was their belief that it should be possible to adapt the combine as used in the western wheat fields to soybeans.

Several harvester companies were contacted and the Massey-Harris Co. agreed to make the trial which was held October 22, 1924.

Twenty-seven and 65-acre fields of AK soybeans were harvested with a 12-foot combine. The late A. E. Buchanan, Massey-Harris engineer of Toronto, followed the machine making necessary adjustments. People from all over Illinois, including farm paper and farm machinery representatives, attended.

The trial was successful and those who came to scoff went home convinced. Several harvester companies came out with combines the following year.

The above photo of the first combine in operation on the Garwood farm is from *Prairie Farmer*, which sent a representative to cover the event.



Above is one of the new self - propelled combines.

vator shovels have been provided, and some farmers have used a weeder behind cultivators to level the soil.

The improvements in the use of machines and power have resulted in the labor requirement per acre being approximately one-third of that required 25 years ago. The studies of the Department of Agricultural Economics of the University of Illinois on farms in Champaign and Piatt Counties have shown this change along with changes due to other factors. One and nine-tenths hours of tractor use, under better methods used in recent periods, have been substituted for approximately 27 horse hours that were used an acre before improvements in cultural practices and power-saving machinery were used in growing and harvesting the crop. A total of 2.7 tractor hours and .5 horse hours are required to produce the crop at the present time. These changes have effected a reduction in the cost for labor, power, and machinery, which, along with reduced land charges, have resulted in a much lower cost for producing an acre of soybeans. With increased yields per acre and improvements in power and machinery in this same period, the labor requirements on a bushel basis are about one-fifth of that required 25 years ago.

TRACTOR POWER

Through a proper combination of machines and certain changes in practices, farmers have not only been able to reduce labor but have also made more efficient and economical use of tractor power in soybean production. It is becoming generally known that the cost of operating a tractor when it is loaded at 25 percent of its capacity is almost as great as when it is loaded to 75 to 100 percent. Studies made by the Department of Agricultural Engineering of the University of Illinios indicate that many farmers can further improve their operating economies by using a combination of machines to take full advantage of the tractor power available as well as to reduce further the labor requirements. Combining the operations of discing and drilling required only 63 percent of the labor and 58 percent of the fuel required to do these two operations separately. These operations come at a time when there is a peak demand on labor, and it is important to reduce the labor requirements to a minimum.

It should be remembered that planting beans in rows and the necessity of cultivating them increases the labor time required. It is important to note that the actual planting width of an 8-foot drill is increased to 9 1/3 feet when planting four 28-inch rows, while the actual planting width of a two-row corn planter is only 7 feet, which increases its time requirement for planting as compared with the drill. There is no advantage over a 2-row corn planter if four 21-inch rows are planted with an 8-foot drill. Time is saved, however, in combining 42-inch rows with a 5-foot combine as the effective width is thereby increased to 7 feet, while only two 28-inch rows or slightly less than 5 feet could be cut with a 5-foot machine. On the other hand, a 6-foot machine could be used to cut three 28-inch rows or a total width of seven feet.

Another saving some farmers have made is by preparing a satisfactory seedbed for soybeans without plowing. This greatly reduces the labor and fuel required, and removes the possibility of plowing up a crop of weed seed which may have been plowed under in previous years.

To determine the over-all effect or the contribution of power and machinery to increased production and yields of soybeans is next to impossible. Timeliness in planting and its relationship to moisture availability, the control of weeds, planting to proper depths, etc., have had their influence on the increased yields that have resulted. However, we cannot express these benefits in exact terms as definitely as we can the effect of the combine on net or harvested yields.

The average yield of soybeans in Illinois as reported for the 5-year period of 1919 to 1923 before the combine was used was 11.6 bushels per acre. Tests of the common methods of harvesting beans during this period showed a loss of approximately 30 percent in Illinois. The average used in the illustration taken from tests, of similar methods, made in Illinois and other states amounts to 28.7 percent. On this basis, the harvested yield was only 71.3 percent of the total produced which amounted to 16.3 bushels per acre. Improved varieties, improved practices, improved planting, use of the combine, etc., have increased the harvested yield, however, to 20.9 bushels per acre during the 1939-43 period. With the combine harvesting method, however, instead of losing 28.7 percent of the beans, only 8.8 percent loss occurs under average conditions. Then the total calculated yield produced during 1939-43 was 22.9 bushels per acre.

The contributions of the various factors resulting in increased yields during the period from 1919 to 1943 have, therefore, increased the harvested yield 80 percent. If we assume that the total crop of 22.9 bushels had been harvested by the methods of 1919 to 1923, the harvested yield would have been 16.3 bushels instead of 20.9 bushels, or the difference of 4.6 bushels could be credited to the combine.

All individuals and groups who have helped to make possible the various power and machinery contributions to increase soybean production and yields are to be commended: the agricultural engineers along with the manufacturers in particular who have improved the combine and adapted it to the needs of the small farmer, who have designed and built new machines and made existing machines better suited for soybean production, and who have virtually made a complete conversion in their harvesting machinery business; the agronomists who have developed better varieties and determined the production requirements needed for maximum yields; the experiment station agricultural engineers and farm managers who have determined the factors influencing efficient use of machinery and labor and other practices that improve production and increase the profit; and the farmers who have used their farms as proving grounds to make the various phases of production practical to the end that the production of soybeans is profitable for the farmer and their use is profitable to the processor.

THE SOYBEAN OIL *Rainbow*

By H. W. GALLEY

AS OUR FIRST troops crossed the Channel to invade Normandy, they saw a rainbow over the coast of France. Whether it is a biblical promise or a legendary myth, it put courage in their hearts because traditionally the rainbow has always been regarded as an omen of success.

On this Silver Jubilee Anniversary of the American Soybean Association we pause to do honor to the founders of our industry. When we think of the courage, the hope and the faith of these early builders, they must have envisioned a rainbow with the legendary pot of gold at the end. What they accomplished in these 25 years has been astonishing. We have seen the crop grow from a few bushels to more than 200 million.

At the beginning there were only one or two crushing plants operating at short intervals. With the impetus of war needs the processing capacity of the industry has been expanded to a point that even the present tremendous acreage does not match the processing capacity. Webster says reflection is wisdom. This may be the time for soybean enthusiasts to become realists. When small quantities of soybean oil first came on the market it entered the tremendous field of oils and fats and had relatively easy sailing. Now that soybean oil represents a very substantial percentage of the country's oils and fats supply its problems are more acute. The present vast soybean oil production is a potential threat to the stability of the industry, both

from the standpoint of the grower and the processor.

The real commercial processing of soybeans in the United States started in 1922. In that year the U. S. and world consumption of fats and oils was much smaller than it is today. In 1922 this country alone produced from domestic and imported materials 7 billion pounds of fats and oils, which included butter and lard. The domestic production of soybean oil in 1922 was 750,000 pounds, or 1/100 of 1 percent. This figure was so insignificant that it easily found a market.

Ten years later the domestic production of soybean oil was 39 million as compared to the total U. S. production of 8 billion pounds of all fats and oils, or about ½ of 1 percent. Still enthusiasm ran high because of the ease with which this amount was marketed.

In 1939, the year before the war, the total fats and oils production was about 9 billion pounds. Of this soybean oil accounted for 458 million pounds, or about 5 percent. Percentage wise soybean oil was steadily gaining against the total production.

In 1943 soybean oil production reached an all-time high of 1 billion 233 million pounds as compared to 11 billion 350 million pounds of fats and oils of both domestic and imported raw materials. In 1943 soybean oil represented 11 percent of our total supply of fats and oils.

From 1932 to 1943 the total fats and oils production in the United States increased 42 percent while soybean oil increased 3,062 percent.

There are two viewpoints to gain from these statistics. The growth of this industry has been outstanding, resulting from the cooperation of growers, processors, chemical engineers, laboratory technicians, and finally through the assistance of our customers who have found ways and means of utilizing the versatility of soybean oil in their products.

On the other hand, we are now at a very critical stage in the development of our industry in realizing that the war has helped materially in disposing of this large production of soybean oil and that the post-war period brings new problems. This has been demonstrated in the present war by the government allocating the entire oil crop for edible purposes. Fortunately, the large number of oil refineries have been able to handle the vast quantities as it poured out of the crude mills. We are living in a day when refining technique and processes have been developed to an amazing degree. Production and hydrogenation capacity in this country has been able to supply shortening, margarine and other products to our armed forces, relief agencies, lend-lease and civilian needs.

A WEAPON FOR WAR

It is well to compare our situation with what happened during the last war. At that time our shipping lanes were open to the South Pacific and the Far East. We were able to bring large quantities of coconut, palm and other tropical oils into this country. Even these imports did not suffice to balance our need for fats and oils for human consumption. Oils are essential to human life and we cannot exist without them. We were dependent on the domestic vegetable oils, cottonseed, corn and peanut as we are today.

Soybean oil was not being produced in this country during World War I, but we imported large quantities of Manchurian soybean oil. It was this Manchurian oil that saved us from fat starvation. We reached the peak of importation in 1918 when we brought in more than 335 million pounds of soybean oil. It is interesting to note that with all the rapid progress that took place in our domestic industry, not until 1939 did we reach soybean oil production in this country in sufficient volume to match the quantity we imported from Manchuria.

In our present war we would have been in far worse condition had it not been for the existence of our great soybean industry. Our source of coconut, palm, peanut and other oriental oils was shut off by the entry of Japan into the war. We had only lard and our vegetable oils to supply not only our civilian needs for food purposes, but to furnish our Army, Navy, Red Cross, relief agencies and Lend-lease, so again we may give thanks to our pioneers for having had soybean oil produced in this country.

The importance of soybean oil as a factor in winning the war should not be underestimated. Few realize how tragic our position would have been without it. There were no other substitutes and we would have had to depend largely on animal oils and fats, which would soon have been exhausted.

The utilization of soybean oil is of prime importance to this industry. Its versatility permits its use in foods and in industrial products. Even though soybean oil has been available in such vast quantities during these critical days, it could not have been used in the manufacture of a diversified line of foods had it not been for the helpful hand of the chemists in our laboratories and the cooperative work of our universities and colleges. We owe a vote of thanks to these tireless workers behind the lines who have delved into the mysteries of converting our great reservoir of crude soybean oil into the palatable foods which we eat. Our chemical engineers have worked unstintingly to develop processes and equipment, and our research men have performed feats which at times seem miraculous.

In the edible industry the largest consumption of soybean oil is in the manufacture of shortening, the second is in the production of margarine. For these two purposes the crude oil is shipped in tank cars to refiners where it is neutralized, bleached, hydrogenated and deodorized. The third largest use is as a refined liquid oil in the manufacture of mayonnaise and salad dressing. For such purposes the crude oil goes through similar refining steps but is not hydrogenated. Further uses are in the manufacture of various food products and for baking purposes.

When the war terminates soybean oil can again enter a large field of industrial uses. Being a semi-drying oil, it must be fortified with driers, or used in conjunction with linseed, tung, perilla or other natural drying oils. It is used in the manufacture of paints, varnishes, enamels, and every type of protective coating as well as in the manufacture of linoleum, oilcloth and waterproof fabrics. That, however, is mentioning only a few of the principal purposes for which the oil is intended because the list of possible uses is a long one.

While soybean oil is interchangeable with certain other vegetable oils in some products, it also has its limitations. It is not alone in its field and particularly since the production has reached such a high point, competition will be very keen and more effort will be needed to dispose of it in the proper channels and at a compensatory selling price. Cottonseed, corn peanut and linseed oils as well as lard and butter production will not cease simply because of the increased quantity of soybean oil available. Also in the post-war period when the shipping lanes will again open to the Far East, we can expect heavy importations of tropical oils in the world markets. We have a greater task ahead than lies behind us.

NEW USES

Soybeans have been so widely publicized that everyone is familiar with them. Accepted uses have been definitely established, but many others will be needed in the post-war period if we are to dispose of a quantity of oil similar to what we have been producing in the last several years. Unquestionably new products are in the making, some of which may be even more important than those now being produced. Research programs are definitely shaped in dozens of laboratories all over the country. Much study is necessary because despite the nutritional, technological and economic importance of constituents found in soybeans, little is known regarding their structure, function and use. While some have been determined, still other substances are undoubtedly present in the soybean, but only a guess may be hazarded as to their identity. Some are so complex that it is difficult to isolate them in the laboratory. Research of this type cannot be hurried and we must not be misled in expecting the impossible.

ECONOMIC PICTURE

With the return in the postwar period of tropical and far eastern oils in the world market, plus a continued high yield of domestic fats and oils, the economic picture is one of sharp competition. Soybean oil in its present state of development has certain uses at rather specific price relationships. A large excess of soybean oil in competition with other oils and fats can only lead to a sharp decline in soybean oil prices or pulling down of the whole oil price structure to a dangerous point.

This situation is high-lighted by the pricing structure which will apply on the current crop. The government has established a minimum price of $2.04 to the grower on soybeans. Likewise maximum bulk, f. o. b. mill prices have been established at $45 per ton for soybean oil meal and 11¾c for soybean oil.

Commodity Credit Corporation has determined that it is impossible for the processor to pay $2.04 for beans and sell meal and oil at the ceilings and has, therefore, entered into processor contracts whereby

● *We must not let the rainbow of hope and promise change to a mirage of disillusionment. In the postwar period soybean oil must find a market on the basis of merit and price. More and better uses must be found or the threat of over-production will become a very real fact. Mr. Galley, manager of the oils division of A. E. Staley Mfg. Co. for the past 14 years, has probably handled more soybean oil than any living man. Formerly he was general sales manager of the American Linseed Co. He is a member of the Edible Oil Refining Industry Advisory Committee.*

the processor buys the beans at $2.04, sells them to Commodity at that price, then buy them back at 16 to 34c per bushel less depending on the type and size of his plant.

It is perfectly obvious that some major adjustments in the price of beans or in the prices of products, or both, must come when support prices on agricultural commodities and OPA ceilings on meal and oil pass out of the picture. Can there be any doubt that over-expansion of the processing industry and even the present vast soybean oil production could be a serious threat to the stability of the industry?

Some may still maintain that if imports threaten our domestic oil economy we can prevent them from coming in through tariff walls. It seems to be generally conceded that world trade is essential to world peace and prosperity. Both political parties in their platforms have emphasized world trade and the realization that if we are to be a great exporting nation we must also be great importers.

Let's never lose sight of the fact that in the postwar period whatever quantity of soybean oil that is produced must find a market on the basis of merit and price. Soybean oil will have to compete on a merit and price basis with cottonseed oil, coconut oil, butter and lard in the food field. On a merit and price basis soybean oil will have to compete with linseed oil and imported drying oils in the industrial field. Soybean oil will have to compete with inedible tallows, fish oils and coconut oils in the soap industry on a merit and price basis.

A large volume of soybean oil definitely has a place on a merit and price basis satisfactory to growers and processors. The question is whether we will develop enough meritorious uses for soybean oil to absorb present volumes of soybean oil production on a satisfactory average price level.

Laboratories and technicians of the country must find more and better uses for soybean oil or the potential threat of over-production will materialize to be a very real detriment to the soybean grower and processor, and perhaps our entire oils and fats economy. It is a challenge we must all grasp with vigor and intelligence. We must not let the rainbow of hope and promise change to a mirage of disillusionment.

WHERE TO IN CORNBELT SOYBEAN PRODUCTION

By G. G. McILROY

OUR SOYBEAN production is now the largest of any nation. Whether this production will drop back to one hundred million bushels annually, remain about the same, or increase another one hundred million bushels, is the question. It all depends on the price offered the American farmer. As long as he can get a per bushel price as good in comparison to prices of corn, oats and wheat as he is getting today, you can look for no decrease in our soybean acreage. It would be, in my opinion, the heighth of folly to venture even a guess as to what the price might be a few years after our wars are over.

The world is overflowing with vegetable oils of low production cost ready to pour into our country just as soon as ships are ready and available for such use. What about the postwar tariffs? Will markets for fats and oils be developed abroad? Will renewed imports of vegetable oils lessen the demand for soy oil? Will proteins, other than those derived from the soybean, depress the price of the soybean when we have fewer animals to be fed?

These are some of the factors which will determine our production in the postwar years. Of one thing we can be certain—progress will be made in securing better yielding varieties, in more efficient methods of removing the oil from the bean, and in developing many new uses for various bean products.

Of the newer varieties, we should consider the Earlyana and the Lincoln—both discovered and developed by Cornbelt agricultural colleges, and experiment stations.

The Earlyana is a new variety released by Purdue in 1943. It is one of the earliest varieties of satisfactory oil content recommended for northern Indiana and northwestern Ohio, being 5 to 7 days earlier than the Richland. It is taller than the Richland, does not set beans so close to the ground and will out-yield the Richland on lighter soils.

The Richland will continue to be a popular early variety on very fertile soils in northern Ohio and Indiana, but it is expected that the Earlyana will largely replace the various other early varieties, on all lighter soils.

The Earlyana will give growers wanting to follow soybeans with wheat, ample opportunity in the shorter season areas to get wheat in the ground by fly-free date or soon after and will yield within 2 to 4 bushels of the midseason varieties such as Dunfield, Illini, Manchu and Mandell, which mature 10 days to 2 weeks later than the Earlyana and are generally too late for wheat seeding. These early varieties will mature when planted later than the midseason varieties can safely be planted.

No Earlyana seed was available for general use in 1944, but there will be quite a little for 1945 and probably plenty for 1946.

McILROY

LINCOLN VARIETY

The Lincoln soybean is the most outstanding of all soybean varieties yet introduced. It is a product and development, primarily of the Illinois Experiment Station and the Illinois College of Agriculture. We Ohioans wish we might claim some credit, yet we are forced to admit that we never saw it until 1939. The Lincoln has been tested for the past 6 years in 82 cooperative tests throughout the soybean belt. Ohio, Indiana, Illinois, Iowa, Missouri and Nebraska cooperated with the U. S. Regional Soybean Laboratory in these tests. The Lincoln has averaged 4 to 6 bushels, or 20 percent higher yield in these tests than such other standard midseason varieties as Dunfield, Illini, Mingo, Mandell and Scioto. Lincoln should now replace all of these varieties including the various strains of Manchu. It also lodged less, had better quality seed, matured at about the same time as the Dunfield and Illini and averaged 8 percent more oil with a higher iodine number. In regional tests in the above states it yielded 5.9 bushels more than Mandell and contained 2.3 percent more oil.

With these definite figures of superiority, it is reasonable to state that the grower, who has Lincoln seed for his soybean acreage, can cut his production costs 25 percent. That is, if it costs him $1.00 to grow 1 bushel of Dunfield, he can grow a bushel of Lincoln for 75c which is a material saving in anybody's business.

There was no Lincoln seed available for 1944 except to growers who have agreed to increase it for seed purposes only. Considerable seed will be available for 1945 and enough for everyone, we hope, by 1946.

Along the line of new uses, we may also expect many new chemurgic developments which, in the aggregate, will require an increasing percentage of our soybean production.

Last February in Columbus we had a two-day meeting sponsored by the National Forecast Council of the Ohio Development and Publicity Commission. A number of outstanding men made very wonderful talks relative to what the postwar years had in store for us. One of these talks was of especial interest to me. It was made by Robert A. Boyer, formerly of Ford Motor Co. and now with The Drackett Co.—you all know him. Mr. Boyer, as a research man, tried to pass on to his listeners some of his enthusiasm for the future of the soybean, along with some practical reasons for his enthusiasm. I am going to attempt to give you sort of a brief of a portion of Mr. Boyer's talk.

Mr. Boyer said that in spite of the large amount of publicity given the soybean oil and the use of the residue meal, containing the high percent of protein, the most

promising and interesting part of the story has not been told.

In our childhood days we learned to classify objects and materials in the so-called "Animal, Mineral or Vegetable Kingdoms."

It is with the mineral group that we, as a people, have reached our highest degree of achievement. As we think of this accomplishment, we must acknowledge that the mineral deposits of the earth's surface have been pretty well discovered and probably are on the way to exhaustion. Sooner or later we are going to have to obtain our mineral supplies from more distant and remote points, or from materials bearing a smaller percentage of the desired elements. Costs will go up. Some nations will not have desirable supplies of necessary minerals.

Let us consider the vegetable world. Man's accomplishment in this kingdom is not impressive. There are over 250,000 species of plants already identified by botanists. Of this number we make use of less than 1 percent, and this 1 percent includes our agricultural industry.

In this vegetable world we find an awful lot of what our scientists call cellulose. The wood from the trees, the stalks and leaves of all plants and crops are mainly cellulose. Today we have vast industries in lumber, cotton, rayon and plastics, all products of a certain type of mechanical manipulation of cellulose. The vegetable world will repeat itself year after year. The science of farming today is, in part, simply a method of controlled production of a very few vegetable plants. Nature really does the job. She gives us an inexhaustible supply, a definite advantage over the limited minerals.

In the plants, the seed is the only part in which we find any quantity of fats and protein. As I said before, the stems and leaves are cellulose.

HIGHEST FORM

The animal kingdom represents nature in its highest and most complex form. In the animal kingdom protein plays the same role as cellulose in the vegetable kingdom. Protein is the essential and all important element in every moving thing and living creature on this earth. But when we look for important industries other than food based on protein to compare with the cellulose developments of the vegetable world, we find none.

Here is where the soybean comes into the picture. This new chemurgic crop makes available to industry for the first time an almost unlimited supply of low cost protein that can be easily stored, handled and extracted in a pure form.

A few years ago, when it was first realized that such an inexhaustible supply of low cost protein could be secured from the soybean, our research laboratories, which were devoted to this type of experimentation, immediately started a program to convert the protein directly from the soybean into fiber instead of feeding it to the sheep and harvesting the wool from the sheep. These research men, after many years of tireless work, are able today to produce a useful fiber directly from the soybean. Although they feel that their present results are crude in comparison to what they will develop within a few years, their present product indicates, positively, that they are on the right track. It requires the produce from 1 acre of land to support 1 sheep for 1 year to produce 8 pounds of wool. If the acre of land is used for the production of soybeans, the scientist can produce 200 pounds of soybean fiber.

All other fibers produced from the vegetable world, such as cotton, flax, hemp, are composed of cellulose. All fibers produced by the animal kingdom are composed of protein. In spite of the fact that many of the cellulose fibers are cheaper and sometimes stronger, man is still dependent on the protein fibers, such as wool, for all uses which require warmth, resilience and the ability to retain a desired or given shape.

And so we have the protein fiber made directly from the vegetable world. It is but the start of a new industry which can be highly important and far reaching in its effects. A new use for the soybean, which at present is profitably utilizing 14 million of our American farm acres.

We will all agree that the soybean is a desirable crop from the farmers' standpoint, if and when the unit price is sufficient to give the farmer some money advantage over other crops. Since laws already passed provide for a floor on farm products, for 2 years after our wars are over, of 90 percent parity, it is certain, in my opinion, that we will have for each of the next 2 years an acreage planted little less than the 14 million we have in 1944.

From 1946 on I am most optimistic.

I have the greatest of confidence in the soybean and in the men behind the soybean industry. I have been intimately associated with both for many years. Difficulties have been met and overcome in the past, and difficulties will be met and overcome in the future. You, my readers, have a similar feeling.

● *Price will be the controlling factor in soybean production after the war, but new varieties and Chemurgic developments will have a bearing. Mr. McIlroy, a former president of the American Soybean Association, is a director of the National Farm Chemurgic Council, and president of Farm Management, Inc., at Irwin, Ohio.*

THE GERMINATION OF *Stored Soybeans*

By R. F. FUELLEMAN and W. L. BURLISON
Department of Agronomy, University of Illinois

MANY factors affect the germination of stored soybeans. Some of these may be listed as follows:

1. The percentage of moisture when stored.
2. Temperature of beans when stored.
3. Atmospheric humidity.
4. Air temperatures.
5. Size and type of storage bin.
6. Percentage of damaged beans.

Most of these are interrelated in their effect on germination. High temperatures, for example, may be due to a high moisture content within the body of the stored beans. This in turn may cause chemical changes in the beans and subsequent loss of germination.

The germination of stored soybeans is apparently most strongly affected by changes in the percentage of moisture during the storage period. Experiments conducted by the Illinois Agricultural Experiment Station and the Illinois Natural History Survey in 1942 and 1943 showed that as the moisture content of beans increased, germination decreased. A similar trend is apparent in the present study. A parallel trend in the storage of soybeans over long periods of time is a gradual loss in germination caused by aging. However, this loss is small during the first year of storage and does not account for any large part of the losses occasioned by high moisture.

In this study, beans having a low moisture content at the time of storage suffered only small losses in germination at the end of 6 months. Beans containing a relatively high percentage of moisture at the time of storage (12 to 15 percent) sustained some losses in germination during the same period.

A large bulk of beans placed in storage when air temperatures are high as often is the case in September, lose heat rather slowly. Atmospheric humidity, probably in conjunction with temperature, has some effect on germination although in the present study the soybeans were stored when air temperatures were low. These factors are difficult to separate. In this study the temperature of the beans in February 1944 ranged from 15° to 32° Fahrenheit. In June the temperature range was 39° to 60° Fahrenheit. The range of temperatures at the time of filling the bins was 26° to 38° Fahrenheit.

Beans for germination tests were obtained from the various bins of the storage project by taking average samples at the time of storage in November 1943 and in January and February 1944. Composite samples and also spot samples were taken again in June and July. These samples were placed in a constant temperature-humidity room until placed in the sand benches of the greenhouse. Duplicate samples of 100 beans were planted in the sand benches at a depth of 1½ inches. At the end of a 9-day period counts were made classing beans as strong and weak in germination or dead.

In this storage experiment weakly germinating beans are grouped with dead beans. Under actual field conditions many weakly germinating beans undoubtedly produce good plants if conditions are favorable. Grouping weak beans with strongly germinating beans does not necessarily change the relative ultimate position of soybeans with respect to keeping quality because beans may be entirely lacking in germinability and show no other external evidence of spoilage.

It is too early to draw conclusions from the work on this experiment.

A cooperative project conducted by the Illinois Agricultural Experiment Station, the Illinois Natural History Survey, and the U. S. Department of Agriculture, Agricultural Research Administration, Bureau of Plant Industry, Soils and Agricultural Engineering, Division of Agriculture Engineering.

The Next
TWENTY-FIVE YEARS

By WHEELER McMILLEN

THOSE here tonight include men who have grown and many of those who have processed and sold the soybean. You have remarked upon the marvelous growth in the production and use of this form of wealth, relatively new to America. Even those most familiar with the story reflect with amazement that a crop of which hardly a million bushels had been grown in a year before the first world war should in this war have become a 200 million bushels a year crop.

I should like, if I were able, to calculate the benefits which have been created for the United States of America by this interesting achievment in production. It would not be too difficult to multiply the annual crop by the average price of each year, and thereby obtain an approximate total of the dollars the soybean has earned for its producers.

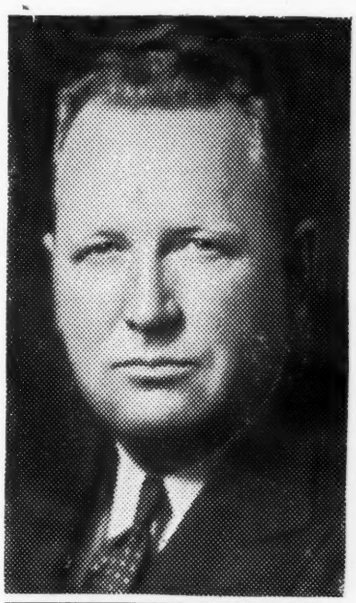
SOYBEANS AND JOBS

That figure, however, would be grossly insufficient. The soybean does not stop its constructive course when it is sold from the farm. These hundreds of millions of bushels have made an enormous number of jobs for men who needed them. During the depression years, from 1930 to 1941, while the demand and production of soybeans were rising steadily year by year, each one of those extra jobs was tremendously important to some family. There were jobs hauling the beans, jobs in the elevators and on the railroads, jobs in the processing plants, jobs in the feed mills, jobs for salesmen and accountants, for chemists and engineers and carpenters and builders that would not have existed during those years had it not been for the rising tide of soybeans.

Because those jobs were created by the production on the farms of a new and needed crop, there was money to buy food and clothing, automobiles and household goods, that otherwise would have found no markets. Thus in turn other new jobs were created to build the automobiles and to dig the iron for them, and there was business for grocers and merchants whose doors might have had to close.

Crowding into millions of acres that otherwise would have been adding to the surpluses of corn and oats not so much needed in those years, soybeans undoubtedly helped to prevent the prices of those and perhaps other crops from falling to even lower levels. The soybean money helped to meet mortgage payments, to send youngsters to school, and to improve the standard of living on tens of thousands of farms.

All this came about by producing a crop of value which met some of the country's needs and for which people were willing to pay. The soybean gave America more protein for human and for animal food. More protein was needed. The soybean gave America an added supply of vegetable oil. That, also, was needed in the national economy. It did more. By stimulating the imagination of scientists and of men of industry, the soybean has become a great industrial raw material out of which old things are being made better and new things are being added to the national standard of living.



WHEELER McMILLEN

● *The miraculous rise of the soybean teaches a lesson that has not been learned by our governmental "planners"—but that lesson must be learned if the promise of the next 25 years is to be realized, says Wheeler McMillen, who as editor-in-chief of Farm Journal and Farmer's Wife and president of the National Farm Chemurgic Council, has long been interested in the soybean.*

No, it is not possible to calculate nor even to estimate what the soybean has done for the people of the United States. We shall have to be content with the certainty that it has added enormously both to the wealth and the welfare of millions of people.

Now let's explore another aspect of the soybean's career. We agree that it has brought a tremendous amount of wealth that we did not have before. From whom was all this wealth taken away?

There are those, you know, who believe that this is a mature nation, a nation that will grow no more. All the pioneering is done. Their doctrine is that since nothing more can be added, the time is come in our old national age when we can only share that which already is in existence. If they are right, this wealth must have been taken away from some one else.

The soybean was brought here from China. Did we therefore take this wealth away from the Chinese? They are probably growing more soybeans than ever before. If they export fewer to us, the advantage is theirs. The Chinese, with a standard of living hardly a tenth as high as ours, have never had enough soybeans nor enough of anything else for their own use. If they grow and use more of the crop themselves they are better off for doing so.

Did the soybean take its wealth, then, away from the producer of corn? I hardly need ask any corn grower here if he believes he is worse off because of this new crop. Did it deprive the oats grower? Obviously not, since he grew fewer acres of oats and more of soybeans.

There is but one answer to this train of interrogation. The great wealth of the soybean is new wealth. The new soybean dollars were created by the toil of farmers out of soil and air and rain and sun; they were made by the work of men in the mills and on the roads and by the salesmen who took the products to those in need of their new values. The soybean dollars are new dollars. They have not been taken away from anybody. They are dollars that would not have existed except for this new crop and the work that has been invested in its production.

The truth, then, must be that they are wrong who say this nation is mature, that no pioneering is to be done, that more new wealth is not to be created in America! The soybean has proved them wrong!

The soybean proves beyond the shadow of doubt that wholly new wealth can be created in tremendous volume.

I have remarked elsewhere that before 1789 virtually nothing had happened in the world to improve the conditions of the masses of people. Since 1789 living conditions of Americans have advanced to a level three times as high as those of any other great nation, and virtually all the occidental world has seen notable advances.

SOYBEANS AND FREEDOM

The one explanation for this is the fact of freedom. The year 1789 marked the first establishment of a government of such limited powers that men were left completely free to exercise their initiative with full hope of reward. The untrammeled freedom of Americans inspired men elsewhere to loosen their shackles. The world moved forward as never before. Wholly new horizons opened up. The existence of new lands to cultivate was a minor and not a major cause of progress. The lands had already been known for nearly four centuries. Freedom was the fuse that set off the energies of men to cultivate the lands and to create the tools with which to multiply their fruits.

The next 25 years may well determine the destiny of all mankind for centuries to come. If freedom and hope cannot survive in America, where alone they have a chance, the whole human race may easily plunge into another era of darkness, dark

ages that may last not for a thousand years but for 10,000 years.

It is entirely possible that there will be another depression in agriculture after this war closes. There is no justification however for such a depression to be permanent or even long. Let it be remembered that America is ready, in agriculture and industry, to serve our 140 million people and more too, with better and more abundant products. Leave unrestricted the incentives to progress and progress will forge ahead, making more jobs as it goes and rewarding toil with more goods.

The function of government is to serve the people. It is not to manage their affairs. There is no wisdom in government except the limited wisdom of individual men who serve in government.

The experience of the soybean affords an excellent illustration of the distinctions between service by government and management by government. When Uncle Sam sent W. J. Morse into Asia to bring back new varieties of soybeans, government was serving the people. When experiment stations developed these varieties, that was service. When public laboratories studied the processes and uses for soybeans, that was service. When colleges and extension forces spread the knowledge of soybean production, that is service. But if government decrees the number of soybean acres on a farm, determines how they shall be sold and at how much, and prescribes for what they shall be used, that is management. Except under the urgencies of war management does not belong to government and in every instance is dangerous to the true welfare of the people.

GOVERNMENT SERVED

Government served in the course of the expansion of the soybean business. However, it was the enterprise of thousands of individual growers and seed producers, the independent chance-taking of processors, and the eagerness of industry to utilize so versatile and meritorious a product. Government managed economy is not open to the expansion of new kinds of production because of the political resistance of those already established. Soybean oil in a managed state would have had no chance to prove its merits in free and honest comparison with established oils.

As farmers consider the adjustments which they may face in the years just ahead, it may be significant to consider the recent past. It is not too much to say that in the Cornbelt, the agricultural adjustment accomplished by the advance of the soybean was more effective, sounder, and certainly more permanent than all the adjustment brought about by federal restrictions and federal checks.

Certainly the soybean offers one lead toward the improved stability of agriculture. Suppose there can be established in the great Wheatbelt another crop or crops that will flourish there as profitably as the soybean has in its present territory. One-crop wheat would cease to be a major agricultural headache. Suppose new crops can be established in the cotton states that will free them from their one-crop dependence upon the vagaries of distant markets? New prosperity would invade the south. Suppose more profitable uses can be developed for corn than to turn it into excessive quantities of lard? The cornfield would become a better standard of security.

Nearly every one of the agricultural sciences is yet in infancy. No one yet knows all there is to know about soils and fertility, the growth of crops, or the husbandry of animals. We have not yet conquered the opposition of insects, diseases or rodents. We have not yet learned to manage water to avoid the ruin of drouths. We do not yet understand the countless biological activities that govern the soil. We have treated the soil as though it were almost wholly a chemical affair, with little regard for the bacterial and other living reactions under its surface.

Only in recent years has science reached a stage where it can even ask, much less answer, the questions that will mean much to the stability and prosperity of rural and of all America. Our applications of machinery and power are still crude as compared to what they can become. Our use of technology in holding more of the profitable processing operations closer to the farm is mostly in the future. More than 300,000 species of identified plants await further examination to determine their uses for the plant scientist and the organic chemist. Certainly there are potential new crops among them. Research to find new uses for the plant materials we produce has hardly started.

The next 25 years may be critical, turbulent and declining years. If they result in the throttling of American freedom, they will mark the turning point toward the decline of civilization, the brilliant interval of the American rise will become a bright speck in the past, and the long slump into ages of darkness will begin.

On the other hand, the next 25 years may mark the rise to new levels of prosperity for agriculture, new security and stability for all our people, new abundance and new hopes for the well-being and peace of the world. Leave our constitutional freedoms unshackled, and we shall lead humanity forward.

INSECTS ATTACKING SOYBEANS STORED IN ILLINOIS

By M. D. FARRAR

● *When the moisture content of stored soybeans is high look out for insects. Dr. Farrar describes the conditions under which insect infestation is most apt to occur. Since 1932 the author has been research entomologist with the Illinois Natural History Suvrey, specializing on insecticides and fumigants and the ecology of insects and plants. He is a member of the American Association of Economic Entomologists and the Entomological Society of America.*

OBSERVATIONS on insect damage to soybeans in storage over the past 2 years indicate that most grain-infesting insects do not damage hard, dry soybeans. When the beans contain moisture in excess of 12 percent, they become subject to attack by several species of insects. At a moisture content between 12 and 14 percent, probably little deterioration will occur from the presence of insects. When the moisture content of the grain exceeds 14 percent, insects that are attracted to decaying organic material may become abundant, with damage to the grain as a result.

The number of insects found in bins of soybeans stored 1 year or longer may be associated with the moisture condition of the beans in the bin. Soybeans absorb moisture quickly and form spots of decaying beans under roof leaks, or along the sidewalls where moisture has entered. Wherever these spots are formed, insects become abundant. Since insect breeding is confined to the area of high moisture, the remainder of the bin is not seriously injured.

Bins of soybeans standing for one or more seasons establish a definite pattern of moisture transfer. Moisture from the lower levels of grain accumulates in the surface layer in a lens-like mass 12 to 24 inches deep in the center, becoming very thin or disappearing within 2 feet of the side walls.

The accumulation of moisture probably never becomes sufficiently high to cause molding in bins filled with soybeans containing less than 10 percent moisture. At moisture contents above 10 percent, the transfer of moisture into the upper layers increases somewhat in proportion to the moisture content of the grain. Data indicate that soybeans with 12 percent or greater moisture content will become moldy in the upper layers within 1 year of undisturbed storage. In bins of soybeans with lower moisture content the moldy area in many cases is not sufficiently large to cause an insect hazard for the entire bin of grain.

In this surface mass average moisture percentages may exceed 20 percent. This moisture change starts in the fall, October-November, within a few days after the beans are placed in storage. The moisture reaches a peak about March, after which the upper layers of grain tend to dry. The following fall and winter additional moisture is deposited to raise the moisture to as high as 25 percent. Where this occurs, decay of the beans is common. In this surface mass average moisture percentages may exceed 20 percent. Molding occurs in the area of high moisture, along with active breeding by several species of insects. Breeding is normally confined to areas of high moisture, but adults may be found in all portions of the grain mass.

Insects that were found to breed freely in soybeans containing moisture above 12 percent are as follows: Indian meal moth, *Plodia interpunctella Hbn.*, breeds in the upper and sidewall layers of grain, feeding

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An Analysis of

THE SOYA FOOD SITUATION

By DONALD S. PAYNE

• Donald S. Payne, soy food expert in the procurement branch of War Food Administration, says public acceptance of soy flour has been very good considering tremendous competition it has encountered from other protein foods. He believes other soy foods are also due to come into the picture.

IF I WERE to report to you that the direct utilization of soya products for food had increased rapidly and continuously, I might justifiably be accused of attempting to mislead you or foster overoptimism. Although substantial progress has been made, it has been neither as rapid nor as continuous as was desirable or might have been expected. Thus, it seems to be an especially opportune time to review the progressive steps which have been made during the past two years and to balance against these advances certain setbacks and unsuccessful experiences, with the view of defining as nearly as possible the road that should lead us to the desired goal.

I believe that the industry now recognizes that although its future is limited only by the nutritional requirements of the world-wide populations for proteins of high nutritional quality, the percentage of this huge ultimate market that can be attained will depend directly upon:

1. The development of products with taste appeal.
2. The development of products that contribute to the improvement of quality in manufactured foods, and
3. The supply and distribution of such products by the soybean industry to consumers and food manufacturers in volume at prices commensurate with economic needs.

I believe that the industry as a whole recognizes the error of offering soya products:

1. As substitutes for other foods,
2. On the sole basis of nutritional quality without regard for taste appeal, or
3. As ingredients at levels higher than are acceptable.

With the entrance of the United States into World War II, our government decided that it was strategically essential to hedge the supply situation on proteins of high nutritional quality against possible shortages of animal protein. This could be most economically and conveniently accomplished by providing increased facilities for the manufacture of soya flour. Government representatives urged the soybean processors to expand their soya flour facilities. Processors responded promptly to this request, even though they were aware of the risk and hazards involved, by expanding their capacities from an estimated 400 million pounds in 1942 to about 1 billion 400 million pounds by December of 1943. This expanded capacity contributed to the overall safety of the war food effort. It was a major contribution to the war effort.

The government gave no specific guarantees on the use of these expanded facilities but the War Food Administration did aid the processors by:

1. Making substantial purchases under lend-lease for delivery to various allied nations,
2. Developing the use of soya products in processed foods for procurement under lend-lease and by relief agencies, and
3. Conducting a nation-wide educational campaign through the facilities of scientific literature, radio, popular magazines, and press on the nutritional and economic advantages to be gained from the use of soya products.

Soybean processors and jobbers developed packages of soya flour and grits for retail distribution at popular prices through normal grocery channels. Nation-wide distribution of these products was obtained.

Thanks to the continuance of favorable growing seasons and the fortitude of the American farmer no protein shortages have developed. True, we have rationing but under our rationing system the per capita consumption of meat has risen from an average 130-pound pre-war level to a level of 158-pounds on the basis of the first quarter of 1944, only 4 pounds shy of the all-time high set in 1908. Production records on pork, beef, veal, lamb, and mutton have risen to unprecedented heights. Production and consumption of dairy and poultry products have shown comparable increases. In the face of this flood of high-quality protein, of the most desirable types, it is really astounding that soya products have made the substantial progress that they have.

The progress that has been made was achieved in a highly competitive market. By virtue of this fact, it should be a more permanent progression than one of larger proportions gained through the aid of shortages and scarcities of other protein foods. It is in itself a reasonable guarantee of future progress.

Total sales on soya flour and grits have risen from approximately 25,000,000 pounds in 1940 to 110,000,000 pounds in 1942 and to 290,000,000 pounds in 1943. The 1943 production was equivalent then to about 3.1 percent of the flour equivalent weight of the total soybean crop. From the first quarter of 1943 up through the first quarter of 1944 sales increased at a relatively progressive rate. Sales for the first quarter of 1944 were at a rate substantially ahead of 1943. Sales in the second quarter of 1944 showed a disturbing drop. This was primarily due to cessation of government purchases resulting from a temporary acute shortage of shipping space for such items as food.

TOTAL SALES

Even though total sales should increase in 1944 over the 1943 level there would still be lying idle a capacity of over one billion pounds. This, of course, is a problem of considerable consequence to the industry. It has been estimated that unless operations can be conducted at somewhere near a 30 percent level of the one billion 400 million pounds expanded capacity provided by processors, a great deal of the equipment will have to be converted to other uses. Operation at a 420,000,000-pound level was therefore set early in this year by the Office of Distribution of the War Food Administration as the immediate goal. Prospects of attaining this goal in 1944 will depend largely upon two factors:

1. Progress of the war in Europe, and
2. Increased acceptance by food manufacturers of the improved lines of flour and grits now being offered by processors.

As the war in Europe progresses, and the liberated areas grow larger, the demands for food must increase. Demands for relief foods may never reach the very high levels predicted by various relief agencies but they will be substantial. Soya products are ideally adapted for relief feeding purposes.

Palatable, low-cost dry soup mixes containing 20 to 25 percent of soya products blended with pea flour, bean flour, dehydrated cheese, or dehydrated vegetables have been developed especially for relief feeding programs. Quick-cooking, dry stew mixes, cereal concentrates, and porridges containing soya have also been developed for such uses. A great deal of work has been done on the use of soya products with wheat flour in bakery products, especially in types of bread commonly consumed by various European nationalities. This latter field has probably the most promising possibilities, both from the standpoint of providing adequate nutrition at low cost to relief agencies and of obtaining increased volume of sales for the soybean industry. It has been demonstrated repeatedly that soya products blend with wheat flour to provide products of superior nutritional quality. Bread in Europe, even to a greater extent than in the United States, is the "Staff of Life." Soya should be used

extensively in the various relief programs now being planned.

Many of the new flours now being offered by processors show marked improvements in color, granulation, and flavor. There must be continued improvements along these and similar lines if the industry is to hold its own or forge ahead in the highly competitive market to which I have previously referred. Some of these improvements are on the way. A recent publication of the Northern Regional Research Laboratory on alcohol debittering, personal communications from chemical supply houses servicing soya processors, and confidential reports from the research laboratories of the processors themselves all indicate that this is true.

Interest in soy milk products and the use of these products in the manufacture of various types of cheeses appears to be growing rapidly. Although these are historically the oldest types of foods prepared from the soybean, production in the United States has never been developed on a volume basis. During the past year at least six large commercial laboratories have been working actively in the development of products of these types both from the whole soybean and expeller and extraction products for large volume production. From the standpoint of edible quality and nutritional value, I am sure that some of the products that have been shown to me by these laboratories can compete successfully in any market if they can be produced at costs making it possible to price them at proper levels.

Members of the American Soybean Association might well take a special interest in all these technical developments, for products developed from the American soybean crop at costs that will allow for open market competitive world-wide distribution in the post-war period may hold out the greatest hope to the underprivileged populations of the world for the fulfillment of the pledge "Freedom from Want." To the American soybean grower and processor, they hold out hope for a market at a time when it may be sorely needed.

The initiative in the development of the post-war market lies primarily within the hands of the industry itself. The government will, I am sure, continue to assist the industry in this development. The effectiveness of any post-war program, however, will be in direct proportion to the degree of cooperation existing between the industry and the various interested government agencies. Agreement within the industry on concrete and definite objectives, therefore, will influence the future plans of government in this connection and implement their administration.

THE BREEDING WORK

of the U. S. Regional Soybean Laboratory

By L. F. WILLIAMS

ONE of the major projects of the U. S. Regional Soybean Laboratory is the development of improved strains of soybeans. We have put a major emphasis on this project because we believe that one of the best ways to produce soybeans more economically is to plant better varieties.

The introduction of adapted varieties makes possible a wider distribution of profitable production. In established areas improved varieties can raise the yield of beans per acre or the yield of oil per acre without appreciably increasing production costs, thus lowering the cost per unit produced. Although the breeding work has been centered at Urbana during the first 6 or 7 years of the Laboratory, large scale projects have also been under way in Iowa, Indiana, Ohio, and Missouri, and in the past 2 years Wisconsin, Minnesota, Nebraska, Mississippi, and North Carolina have increased the scope of their breeding programs.

Some of the ways in which soybeans may be improved are as follows:

1. Increase the ability to produce seed.
2. Increase the resistance to lodging.
3. Increase the resistance to disease.
4. Increase the resistance to insects.
5. Select for more suitable maturity, i.e., earlier or later strains for certain sections.
6. Improve the chemical composition.

The attempt to increase the yield per acre has received the most attention in the breeding work until recently. There are two reasons for this. First, yield is the most important characteristic and the one most intimately connected with production. If a new variety yields better than the old, farmers are quick to see the advantage of the new strain. Second, an increase in yield of beans per acre has seemed the easiest way to increase the yield of both basic soybean products, meal and oil. So far it has not been difficult to find in almost any segregating population, strains which exceed the yield of the parent varieties. In our present crosses we can hope to secure strains yielding 10 percent more than the parent varieties. Of course, as the level of production is increased in each breeding cycle it probably will become more and more difficult to improve upon the yielding ability of the parent lines.

LODGING RESISTANCE

Selection for resistance to lodging has also received considerable attention. The Iowa program has especially stressed this characteristic since lodging is quite an important factor in certain sections of that state. Richland has been the most outstanding strain in regard to lodging resistance. This resistance is easily recovered in crosses between Richland and other strains. Due to its relatively early maturity and lodging resistance Richland has entered into a high percentage of the crosses in the northern breeding programs. Patoka and Illinois T117 also contribute considerable lodging resistance to their crosses.

In the South, Ogden seems to be a promising parent where resistance to lodging is needed, especially on the heavier soils. So many selections from the Richland and T117 crosses look promising that selections from these crosses make up far more than their share of the entries in the preliminary yield trials. It should be pointed out that all of these strains mentioned above are determinate in habit and that a portion of their lodging resistance is due to this characteristic.

DISEASE RESISTANCE

To date very little has been done in regard to selection for disease resistance, since the pathological program of the Laboratory has been under way such a short time. However, real progress is being made and it is hoped that in the near future methods can be worked out to test the resistance of selections to a number of impo tant diseases. No clear-cut cases of immunity have been observed in the northern states, but some indications of resistance to Sclerotium rolfsii and root knot have been observed in the South and breeding work is under way in North Carolina to transfer this resistance to several of the better commercial strains such as Ogden and Volstate.

The Laboratory has not initiated any work in regard to selection for insect resistance.

Date of maturity is an interesting character to work with. In the northern states some varieties are grown with maturities (at Urbana) of 85 days, while the southern states have some which need 185 days to mature. This means that separate breeding programs must be undertaken to supply strains of the proper maturity for each region.

In general, strains which mature during the hot dry weather of July and August produce poor quality seed, but there is some variability in this respect. For some purposes an early maturing bean is desired and an attempt is being made to secure strains which will mature in early fall and still produce good yields of good quality beans. In much of the South and parts of southern Indiana, Illinois, and Missouri seed quality is a major factor limiting soybean production. This is closely related to date of maturity. The varieties Patoka and Gibson have helped fill the need for strains of suitable maturity and are able to produce good yields of good quality seed in southern Illinois and Indiana.

It is a rather common thing to find transgressive segregation for date of maturity in soybean crosses. For instance in a recent cross between Lincoln and Richland, we found some selections which were 10 days earlier than Richland, the earlier parent, and others a week or more later than Lincoln. This fact is of considerable help in breeding work. The cross referred to was made to combine the high yield and chemical composition of Lincoln with the earliness and lodging resistance of Richland. Without the necessity of introducing a third variety, we have gotten strains early enough to go much farther north than either of the parent strains.

Ever since the foundation of the Soybean Laboratory we have placed considerable importance on the chemical composition of soybean varieties. The fact that most soybeans are processed for oil and meal makes

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● *A report on the uniform testing work of the Laboratory in the various states and the results to date. The author is associate agronomist of the U. S. Regional Soybean Laboratory.*

SOYBEAN STORAGE *Studies*

By DEANE G. CARTER and LEO E. HOLMAN

THE STORAGE of soybeans on the farm involves problems of properly designed structures, insect infestation and control, the maintenance or improvement of the quality of stored beans, and the effect of typical farm storage on the market grades, condition, and quality.

A comprehensive study was established at the Illinois Agricultural Experiment Station in 1943, in order to find the answers to some of the many questions that relate to farm storage. The problems of storage can be solved only by the continued study of full-sized farm-type bins with sufficient duplication to verify the results. The Illinois project has not been in operation long enough to warrant conclusions. Nevertheless, considerable progress has been made in methods of operation and in tentative results that indicate the need for more detailed study.

The project facilities include 67 storage bins of various types. About 60,000 bushels of soybeans were stored in 1943 at different moisture contents and in various types and sizes of bins. The comparisons of structures include the following:

Bin sizes: From 760 to 2,800 bushels.

Bin colors: White, black, red, and natural galvanized steel.

Bin shapes: Round, square, 12-sided, and oblong; depths from 6 to 13½ feet.

Construction materials: Steel sheets, matched boards, painted plywood, and asphalt-covered plywood.

Foundations: Crushed rock, concrete blocks, and earth fill.

The data necessary to make comparisons include: (1) temperatures, (2) moistures, (3) market grades, (4) insect infestation, (5) germination, (6) oil content, and (7) fat acidity. In some phases of the study it was necessary to record also pressures, relative humidity, and wind velocity. Some data were secured on the respiration rate.

Temperatures were determined by the use of thermocouples within the mass of grain; not less than seven junctions were used in any bin, and as many as 55 were used in certain bins for complete data. Moistures were obtained on all samples taken, usually on a standard "Tag-Hep" moisture meter. Market grades were determined principally by the War Food Administration, Chicago, Ill. Data on insect infestation, germination, oil content, and fat acidity were obtained by standard experimental methods as outlined in separate reports made by the cooperating agencies and departments.

A cooperative project conducted by the Illinois Agricultural Experiment Station, the Illinois Natural History Survey, and the Bureau of Plant Industry, Soils and Agricultural Engineering, Division of Agricultural Engineering, Agricultural Research Administration, U. S. Department of Agriculture.

● *First report of soybean storage studies being carried on cooperatively at the University of Illinois. In 1943 60,000 bushels of soybeans were stored in 67 bins of various types. Mr. Carter is professor of farm structures in the Department of Agricultural Engineering at the University of Illinois. Mr. Holman is agricultural engineer of the U. S. D. A.*

The following report includes the principal phases studied during the year and the observed indications of storage factors that affect soybeans.

Pressure panels similar to those used in previous studies of corn, wheat, and corn and grass silage were installed in two soybean bins. Pressures were determined by measuring the deflection of calibrated steel rods supporting panels 2 feet square throughout the depth of the beans. The average maximum lateral pressure on the bottom panel was 145 pounds per square foot, or approximately 16 pounds per square foot per foot of depth at 9 feet from the top. (The average of pressures on the bottom panel.) Calculated pressures based on Janssen's formula indicated 164 pounds per square foot at 10 feet down. The measured angle of repose for soybeans was 26 degrees.

RESPIRATION STUDIES

Six samples from representative bins, tested by W. E. Geddes of the Minnesota Station, indicated that the respiration rate remains low and relatively constant in beans with low moisture content; at moisture above 14.5 percent (approximately) the daily rate increases steadily for several days then tends to remain constant.

Observations on 1942 soybeans stored in bins in various areas of Illinois indicated a definite tendency for the air movement through the mass of beans to pick up moisture from the body of the bin and deposit it near the top center. Dangerously high moistures of 15 to 19 percent were found in the upper parts of bins that averaged 12 percent or less when stored, the highest moisture occurring in the winter. The same tendency was observed in all bins included in the 1943-44 studies. This moisture redistribution was more pronounced in steel bins than in wood; more in large wood bins than in the smaller ones; and more in high moisture beans than where moistures were low.

It is reported by AAA officials that very low moisture beans (8 or 9 percent) were so dry that the split and mechanically damaged beans caused by binning and reloading frequently resulted in the loss of one or more market grades. In the present studies moisture contents of 14.5 percent or higher were associated with the higher respiration rate, greater moisture redistribution, more insect infestation, higher bin temperatures, decreased germination, and similar indications of deterioration. These indications of deterioration were not associated with lower moisture contents. This indicates that soybeans of 10 to 12 percent are perhaps best for safe storage, although more research is needed to establish exactly the safe moisture limits.

MOISTURE CHANGES

There was an increase in the moisture content of virtually all stored beans. The unweighted average increase was six-tenths of 1 percent for the period December to June.

Based upon average bin samples, there was no serious deterioration in storage (up to September 1, 1944). Germination declined in most cases, but not seriously. Only in the higher moisture bins was there any definite decline in germination (average 18 percent). Fat acidity tests indicated a definite increase principally for the higher moisture beans. The only grade changes were due to variations in the proportion of split and damaged kernels.

A "shelf" bin, in which sloping wire shelves were used to give the maximum exposure of the beans to the air, gave a decrease of 1.4 percent in moisture to June 20; other bins, including the bins equipped with ducts, perforated walls, and downdraft ventilators, showed no decrease, or a slight increase. Four bins were specially equipped with downdraft ventilators, air ducts to an A-frame, and air outlets above the mass of beans; after four and one-half months no important changes were found as the downdraft ventilators were not effective in producing air circulation. The drying of the beans in the shelf bin and the reduction of moisture by a suction fan attached to one of the ventilated bins indicate that under certain conditions drying can be accomplished with unheated air; definite recommendations, however, are not warranted on the basis of present information.

Temperature records, varying from seven to 55 thermocouple readings were made in each bin at frequent intervals. The average minimum temperatures were reached in February or March; the maximums are expected in late August or September. There was a rise in average temperature of about 30 degrees, Fahrenheit, from February to June. There appears to be some advantage in the rock foundation and block foundation as compared with earth fills in getting faster cooling in the interior of the bins. Higher June temperatures occurred near the top of the grain in the dark colored bins. In general, temperatures were somewhat higher in the south quadrants of the bins. Within the range of conditions encountered in 1944, no difficul-

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UTILIZATION OF SOYBEAN OIL MEAL AS FEED AND FERTILIZER

By Dr. J. W. HAYWARD

● *Soybean oil meal, having found wide acceptance as one of the finest and most versatile of protein concentrates, now is in very wide demand. Will it retain its new-found friends after the war? Dr. J. W. Hayward, director of biological research and development of Archer-Daniels-Midland Co., Minneapolis, surveys the situation. He believes utilization should continue to expand if research programs are kept up and as experience grows.*

SOYBEAN growers, like all producers of raw materials, are looking forward to the postwar period and wondering just what the future holds for them. How many soybeans the grower will attempt to produce is normally dependent upon the economic aspects involved. Here the price per bushel of soybeans in relation to the price for other staple crops is very important in the mind of the grower.

The primary product of soybeans is soybean oil meal. Approximately 80 percent of the soybean is converted to meal products by the processor.

Just prior to declaration of World War II the production of harvested soybeans was increased rather consistently from year to year. Approximately 2 million tons of soybean oil meal were produced from the 1941 soybean crop. This compares with a total domestic production of all high-protein concentrates during the pre-war period of 5 million to 6 million tons annually. These figures include dry-milk products as such and the equivalent, fed as liquid milk on the farms.

Under the impetus of the war our present production of soybean oil meal is about 3 million tons annually and compares with a total production of high-protein concentrates of about 11 million tons.

The tremendous increase in livestock numbers has provided a strong demand for high protein concentrates produced during the past 2 or 3 years. In planning for the future, however, we should not forget that during the pre-war period 5 million tons of these protein concentrates were considered a burdensome supply for our country as a whole and most of us still recall those days when soybean oil meal sold at $20 per ton and less F.O.B. the mills, and rather hard to sell at that figure.

DEMAND STRENGTHENED

However, the demand for soybean oil meal in the post-war period will be strengthened by the widespread familiarity with its proven nutritional properties. Because of aggressive research and expanded wartime usage, many of the nutritional values of soybean oil meal were quickly revealed. Ten years ago, yes, even 4 years ago, there were many who were not familiar with the qualities of soybean oil meal. Today soybean oil meal is widely accepted as one of the very finest and most versatile protein concentrates available.

Soybean producers may well ask if we can expect further advances in the science and technology of using soybean oil meal in animal and poultry rations. This is a fair question because further improvements will expand the market for soybean oil meal. If it is fair to predict the future of soybean oil meal on the basis of what we have learned about the older, more established protein concentrates, then it can be said without question, that we still do not know all there is to know about soybean oil meal.

Meat scraps and fish meal, for example, are old established proteins and yet even today we are still learning pointers on what it takes to make these ingredients function in rations for livestock and poultry. The amino acid approach to protein quality has merely been scratched and I predict that this is one phase of protein concentrate studies that will receive a great deal of attention during the years ahead. I have further confidence that such a study will not limit the utilization of protein concentrates, but rather provide greater knowledge of their makeup and thus make it easier for the consumer to utilize them to best advantage.

The great percentage of our soybean oil meal production is used in animal and poultry feeds. You may well ask just what we can expect in the way of utilization by the various classes of animals and poultry on the farm or in the commercial feed lots or specialized production units.

Dairy cattle have normally constituted a demand for 50 percent of all the vegetable protein concentrates produced. During times of normal supply and competition we can expect that soybean oil meal will sell to dairy farmers on the basis of its cost per pound of digestible protein as these consumers do not generally pay a premium for protein quality. In this respect soybean oil meal will have to be placed in a class with some of the other protein materials which have not been generally praised for their efficient protein.

Beef cattle and sheep do not normally constitute a very large outlet for high protein concentrates except in times of very large production and low prices. These animals normally utilize a large proportion of roughage to concentrates. There are periods of about 3 months out of the year when range cattle and sheep are fed protein concentrates; even then the quality is limited.

No one seems to know just what percentage of our total protein concentrate supply can be utilized by beef cattle and sheep during normal times. The Feed Industry Council, in their recent estimates on feed usage for 1944, have allotted beef cattle and sheep 20 percent of the total supply of high protein concentrates. This figure may be a trifle conservative for the future because feeding margins do not justify highly finished beef and lamb. Under the free economy of pre-war years many beef cattle and sheep were fed in feed lots for periods of 3 to 6 months. During this time they normally received a protein concentrate in addition to the usual grain and roughage ration.

If soybean oil meal should ever be priced as cheaply as it was several years ago, beef cattle and sheep feeders can well afford to use it as a substitute for corn. Quite extensive work has been conducted at the University of Illinois on this very subject. They have found that beef cattle gain even more rapidly when soybean oil meal is fed with corn in the proportion of about 1 part soybean oil meal to 4 parts of corn, or 1 to 2 than they do when the proportion is 1 to 7. Dressing percentage and selling price also favor the higher levels of soybean oil meal. These studies have shown that soybean oil meal is actually worth more when fed at high levels than when fed at a ratio of 1 to 7.

LAMB RATIONS

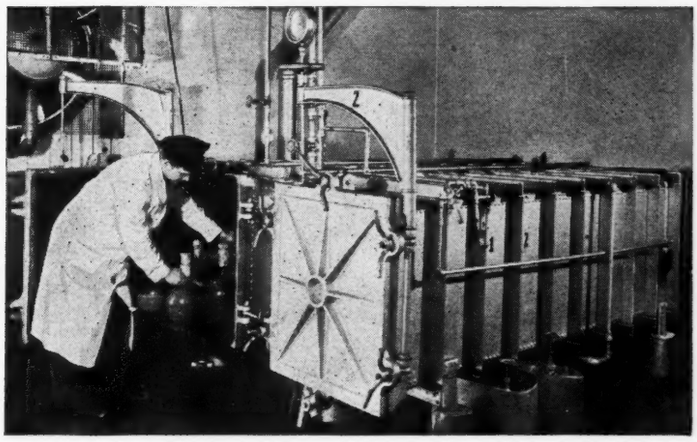
In the case of lambs it has been demonstrated that soybean oil meal may actually replace all of the corn in a standard shelled corn, corn silage, soybean oil meal ration. Lambs which received .84 lbs. of soybean oil meal daily and no corn actually gained more rapidly than when the soybean oil meal and corn were fed in the standard proportions of 1 to 7 and 1 to 9.

Hogs constitute the greatest potential demand for protein concentrates of any class of farm animals and poultry. Hogs belong to the class of critical animals which require protein of high quality for maximum development. For that reason soybean oil meal, when properly processed, is considered a favorite protein concentrate for hogs.

Recent advances in hog nutrition have emphasized the need to maintain adequate levels of minerals and vitamins regardless of the protein source. This is of basic importance in all rations. When this practice is followed soybean oil meal can supply the major portion of supplemental protein in all types of hog rations.

If we consider hog production in the United States during 1940 as a fairly normal year and if we fed these hogs properly balanced rations with respect to protein, there would be a potential annual need for 3 million tons of soybean oil meal, even if soybean oil meal supplied only half of the supplementary protein. Thus we see that if the various established agencies are successful in putting across an educational campaign for the proper nutrition of hogs, this class of animals can very easily become our greatest outlet for soybean oil meal and an outlet that will possibly justify an

SOYBEANS and NOD-O-GEN "GREW UP TOGETHER"



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increase in soybean oil meal over our present production.

Poultry, is, of course, our most dependable consistent outlet for protein concentrates. The poultry population of this country is normally fairly steady. Its fluctuations are less violent than in the case of hogs. Poultry, like hogs, responds to proteins of high quality and thus a premium is placed on soybean oil meal for use in poultry rations. Here again, correct processing and supplementation of soybean oil meal is necessary for maximum results.

I consider it appropriate to give credit to the poultry industry for pioneering soybean oil meal more aggressively than any other animal industry. This group was first to learn just what it takes to make soybean oil meal function properly in a complete feed. It was the poultry industry that first placed emphasis on properly cooked soybean oil meal. With emphasis on poultry requirements for quality protein, the extracted or 44 percent soybean oil meal came into high favor.

Fur-bearing animals, rabbits, dogs and other pets, may possibly become a more important outlet for soybean oil meal than they have been in the past. They have been the last class of animals to accept soy products as a protein ingredient, with the possible exception of dogs. Although the protein quality of soybean oil meal is very satisfactory for fur-bearing animals, such as foxes and mink, there are apparently other factors to consider in making soybean oil meal most useful for these animals. There are now an estimated 15 million dogs in the United States, so we must admit that these animals themselves constitute a very large potential demand for feed ingredients.

Thus far the outlet for soybean oil meal and other organic materials for fertilizer purposes has been comparatively small. During a normal year 50,000 tons of all organic fertilizers is considered a relatively significant tonnage. During the war years this tonnage has been reduced to an estimated 20,000 tons. Of course, as you know, soybean oil meal has been restricted for feed purposes and not permitted for use as a fertilizer during our present emergency. The over-all demand for fertilizer varies, of course, but during the present year, there is an estimated demand for probable delivery of some 11 million tons of fertilizer.

ORGANIC FERTILIZERS

There are many advantages to organic fertilizers. Soybean oil meal has already proved itself as a reliable carrier of organic nitrogen. Fertilizer tests at the Connecticut Tobacco Experiment Station have shown soybean oil meal to be significantly superior to cotton seed meal as an organic fertilizer. This superiority is based on the greater availability of the nitrogen in soybean oil meal.

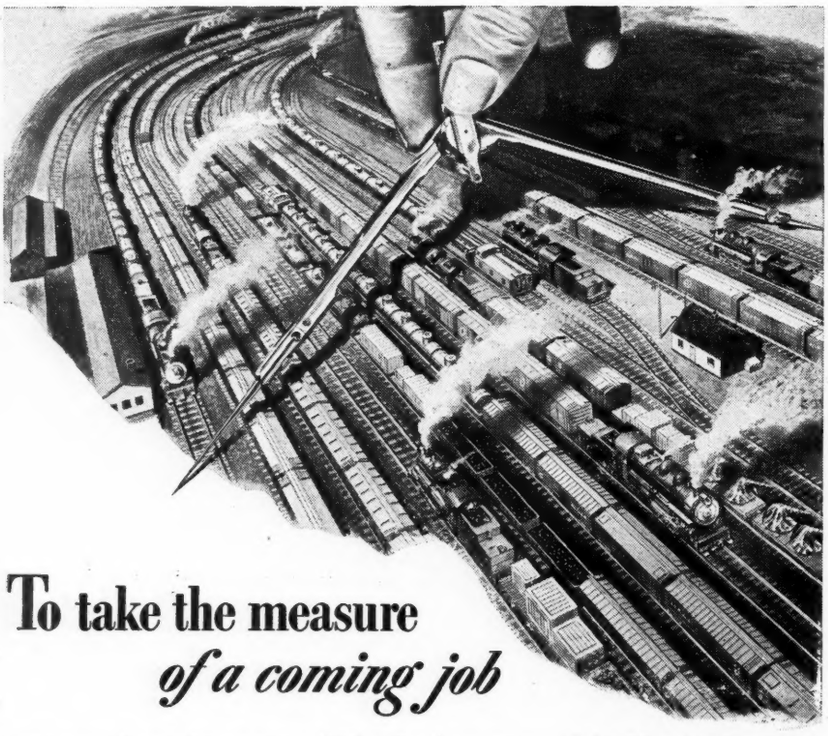
Some will question the logic of raising soybeans to produce soybean oil meal for fertilizer, yet here is an interesting analogy. It has been estimated that 1 ton of complete fertilizer produces grazing equal to 11,500 pounds of milk or 1,400 lbs. of beef. If we incorporate soybean oil meal in a mixed fertilizer which is complete for producing grass, then we can arrive at the apparently ridiculous assumption that 1 ton of soybean oil meal is equivalent to 1,400 pounds of beef.

Whether or not soybean oil meal is used directly as a fertilizer or indirectly through feeding to animals, it is imperative to deliver the greatest percentage of soybean oil meal to the farm as soybean oil meal, for thus used, it aids in maintaining a reasonable balance in soil fertility.

The future position of soybean oil meal can be affected by a great many factors. These of course, include the total supply of all animal and vegetable proteins, so-called synthetic proteins and amino acids which, in some cases, might strengthen the position of soybean oil meal and in other cases reduce the need for it and other protein concentrates. Then there is urea, an inorganic source of nitrogen, 7 times more potent in nitrogen content than soybean oil meal and other similar products of high protein content. Urea is being widely publicized due to a few university experiments which have shown it to have fairly satisfactory protein replacement value in dairy rations.

While there are competitive materials which might restrict the general use of soybean oil meal, there are also materials which might supplement soybean oil meal and expand its utilization. Examples of such products are high quality fish meals, noted for their high levels of sulphur containing amino acids. These amino acids are slightly deficient in the usual commercial grades of soybean oil meal. Moreover, there are even some vegetable products which yield a remarkable supplementary effect when used with soybean oil meal. One of these is sesame meal. Still another is corn gluten meal. There are some indications that soybean oil meal and wheat have a mutual supplementary effect for certain types of rations.

Continued research and experience with soybean oil meal, a relatively new protein concentrate, cannot help but expand its utilization. However, total domestic use will always depend, to a large extent, upon our animal and poultry population in relation to the total feed supply.



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SOYBEAN RESEARCH

A Look into the Future

By O. E. MAY

TO ESTABLISH a base from which we can estimate the future, it is desirable first to survey the past. A survey of the history of the development of the soybean industry in the United States is both interesting and enlightening. Being a research man, of course, I will talk about the part that research has played in the development of the soybean. For this purpose I wish to return briefly to the early part of 1936, the time at which the U. S. Regional Soybean Industrial Products Laboratory was authorized by the Secretary of Agriculture. At that time it was apparent that much needed to be done and that a centralized laboratory could perform useful services not only by its own research but also by collecting information for all those wishing to advance the industrial utilization of soybeans.

In November 1937, a conservative economist stated, "In view of the uncertainty as to future demand conditions, a marked or too rapid increase in the production of soybeans for crushing does not appear advisable. Although facilities are available for processing and marketing a much larger crop than has so far been produced, there has not been an opportunity to observe the marketing of the crop under normal competitive conditions. The quantity of soybeans that can be marketed at favorable prices compared with those prevailing for competing products has not yet been demonstrated; and it is not clear at present to what extent soybeans and soybean products may tend to replace other products. Experience in the next few years will probably give a more definite indication concerning the position that soybeans are to fill in American agriculture and industry." (Technical Bulletin No. 619, U.S.D.A., page 25). These were the conditions that existed in 1936 at the time the Soybean Laboratory was established at Urbana.

WHOLEHEARTED COOPERATION

One of the most important factors in the Laboratory's research on soybeans in the past and one of the best omens for progress in the future is the wholehearted cooperation between all parties concerned. The program of the Laboratory was outlined and the location fixed at a conference between the agricultural experiment station directors of North Dakota, South Dakota, Nebraska, Kansas, Minnesota, Iowa, Missouri, Wisconsin, Illinois, Indiana, Ohio, and Michigan, and U. S. Department of Agriculture representatives. Suggestions on, and assistance in, formulating the program were also received from the National Soybean Processors Association, individual soybean companies, and, last but not least, the American Soybean Association.

In the physical establishment of the Laboratory, great credit is due to Dr. W. L. Burlison for his wise guidance and assistance. Through Dr. Burlison and the late Dean Mumford, every facility of the University was placed at our disposal, and Dr. Burlison's keen interest and enthusiasm have been a continued support to our program. Laboratory work was also undertaken at the agricultural experiment stations of Indiana and Minnesota under the direction respectively of Doctors H. R. Kraybill and C. H. Bailey. These two men, together with colaborators appointed from the other states mentioned previously, have contributed to the success of the Department's research on soybean utilization.

● *Copra and other oilseeds are being stockpiled in the South Pacific, awaiting the end of the war, when they again will come knocking at our doors. When that day comes soy oils may suffer severe competition and the vigorous program of research for new outlets now being conducted at the Northern Regional Research Laboratory may prove to be good insurance against a depression in the soybean industry. Dr. May, as chief of the Bureau of Agricultural and Industrial Chemistry, administers the four regional research laboratories. He organized and directed the Northern Regional Research Laboratory at Peoria, from the time of its establishment in 1939 to 1942. Prior to that he organized and directed the Soybean Industrial Products Laboratory at Urbana. Forty-two years old, Dr. May is one of the younger men in responsible research positions.*

In July 1942, the chemical and engineering research of the laboratory was transferred, by an act of Congress, from Urbana to the Northern Regional Research Laboratory at Peoria. The years from 1936 to 1942 had been productive. Studies on soybean oil meal had shown under what conditions the protein could be removed and how it could be subsequently used in paper and leather coatings, sizings, and for fibers and plastics. Other work showed the possibility of using solvent extracted soybean oil meal in plastics, and such material was used commercially. Extensive analytical work had led to new and quicker methods, and assisted the agronomists in developing new varieties which are now of benefit to growers and processors. The development and release, in cooperation with the experiment stations, of such varieties as Lincoln, Gibson, Patoka, and others will repay many-fold all of the expenditures for soybean research at the experiment stations and the Regional Laboratory. Work of the oil section of the Laboratory at Urbana extended the use of soybean oil in protective coatings and added to our knowledge in the problems of refining and stabilizing the oil. Much information on the details of processing soybeans and the economics of this industry was compiled and given to interested inquirers such as cooperative and prospective processors. This information frequently deterred ill-advised groups from entering fields where their chances for success were very small.

In 1939, when soybeans were harvested having a green color caused by abnormal weather, the Laboratory was able to demonstrate that the damage did not seriously affect the value of the oil and meal, and as a consequence the discounting of this "green damage" was held to a minimum with savings to the producers.

REMOVAL TO PEORIA

Removal of part of the Laboratory to Peoria has resulted in an expansion of all phases of soybean research. Increased facilities at the Northern Regional Research Laboratory have permitted faster progress on the chemical and engineering program. In the brief period since the move to Peoria, Norepol and Norelac have been developed. Both of these products are based on certain polymerized fat acids for which soybean oil is by far the largest source. Study of the separation of soybean oil into fractions by liquid-liquid extraction was started at Urbana and is being actively continued at Peoria. Results are most encouraging, and the portion remaining after extraction of the highly unsaturated acids promises to be an outstanding edible oil. The work on soybean oil meal continues, with recent developments leading to its possible use in new plywood adhesives which have expanded and are assuming great importance.

Research workers are not expected to be crystal gazers; but, in order to direct their research toward building a sound future for soybean production, the scientists must be guided primarily by whatever economic difficulties they can foresee for the industry. A cursory look into the possible economic status of soybean products is therefore a logical preliminary to the exploration of the possibilities of research.

Right now, soybean products are in tremendous demand, but we are all at least slightly fearful of the future, when the demand may lessen considerably and we may be faced with surpluses. Until Europe is rehabilitated, it is generally felt that fats, oils, and protein feeds will continue to command favorable prices. *However, copra and other oilseeds are being stockpiled in the South Pacific, awaiting the return of normal transportation.* New sources of vegetable oils have been developed in South America.

In the case of soybean oil meal, too, the immediate future appears satisfactory, that is, as long as we must feed Europe. There will surely come a time, however, when

Europe will no longer need the vast quantities of food we are supplying. We must build for the more distant future when, as in the years immediately preceding this war, soybean products may again have to compete with ominous surpluses of other commodities which are equally acceptable to the consumers. The Agricultural Research Administration of the U. S. Department of Agriculture has been cognizant of the surpluses that may some day return and has research in progress which, if fruitful, should result in many new developments for the industry to use in meeting such a situation.

When surpluses return, soybean meal may occupy a more favorable position, relatively, than it did in 1938 and 1939. Its value as a feed has been so overwhelmingly proved during the past few years that its place in the feed industry is firmly established. The future for soybean oil, however, seems less promising unless, through research, means can be developed for enhancing its competitive position among possibly surplus supplies of oils and fats. Broadly, our research programs are aimed toward the solution of these problems in two ways: First, by increasing the value of soybean products for the uses now being made of them, and second, by developing new industrial uses for the oil, meal, and minor constituents obtained from soybeans.

The Northern Regional Research Laboratory at Peoria has already obtained most encouraging results from a study of one aspect of this problem; namely, the production of a soy flour with superior flavor characteristics, and the preliminary results have literally paved the way to a most promising field for further research.

It is possible to mention only a few of the many auspicious lines of research being prosecuted toward the development of industrial products derived from soybean protein. In the past, plastic materials, adhesives, and paper coatings have resulted from such research, and films and fibers made from soybean protein now seem destined to assume industrial importance. The search for new uses is being constantly furthered by advances in our knowledge of the chemical and physical nature of soybean protein. It is a most complicated substance, but those features which contribute to its complexity are the very ones which lend it valuable properties. The intricacies of the various protein molecules are slowly but certainly being unravelled, and with each new advance in our understanding of the chemistry of soybean protein, new possibilities are presented for the improvement of products made from soybean meal with consequent enhancement of their value.

FUTURE DIFFICULT

The future of soybean oil presents a somewhat more difficult problem than does that of soybean meal. Many refiners have not yet developed methods for processing it into some products that will compare favorably with similar products made from oils that are temporarily scarce but which have been preferred by the refining industry in years past. All refiners have increased the proportion of soybean oil processed in their plants to an extent undreamed of a few years ago, but most of them state quite frankly that they would prefer to use other oils which are now either unavailable or in restricted supply. When these allegedly *more* desirable oils are again plentiful, demand for soybean oil seems destined for a definite decline unless some of these minor shortcomings can be overcome. The industry is fully aware of this problem and has sought its solution for many years. Excellent progress has been made, but the war-stimulated increase in soybean oil consumption in food products has brought the problem into prominence, and it must be solved if soybean oil is to hold the gains it has made.

In industrial fields, soybean oil has a vast future, particularly in the production of coatings and other polymeric products. Soybean oil is a mixture of materials some of which are ordinarily considered best suited for use as foods and of others that are best used in paints and varnishes. In the past, it has not been economically practical to separate these constituents, but means for so doing have recently been developed. The perfection and intelligent application of fractionation processes, separating individual components for specific uses, are undoubtedly the key to future expansion in the industrial use of soybean oil.

In their simplest application, the new fractionating tools will be used to separate soybean oil into two fractions, one of which has been found to be an exceptionally fine edible oil, and the other of which is excellent for use in paints and varnishes. Both portions will be worth much more than the original oil, and exploitation of the process on a large scale would alleviate to some extent the possible surpluses of edible oils which impend.

NOREPOL— NORELAC

Fractionation of soybean oil has more far-reaching possibilities, however since the principal constituent is linoleic acid, which comprises over 50 percent of the various fatty acids making up the oil molecules. This acid appears to be the most valuable product obtainable from the ordinary fats and oils, from the standpoint of industrial utilization. Linoleic acid can be used as the initial raw material for making a wide variety of synthetic products. Typical examples, developed at the Northern Regional Research Laboratory, are Norepol, a rubber substitute, and Norelac, a new resin having remarkable properties. These materials have been described to this group on previous occasions, and samples are on display in the exhibit prepared for this meeting by representatives of the soybean industry. However, these products represent only the beginning of what will undoubtedly in due time become a very large industry based upon the commercial separation of the constituents of soybean oil and their use as industrial raw materials.

Paints and varnishes have provided a comparatively small outlet for syobean oil in the past. However, the stimulus of war has fostered new developments in the art of modifying soybean oil to impart fast-drying properties. The mechanisms involved in effecting structural rearrangements which result in more rapid polymerization are now much better understood than they were a few years ago, and the application of our newer conceptions of this phase of oil chemistry may result in far-reaching changes in the field of protective coatings.

Soybeans contain many minor constituents of industrial importance, a few of which are now being recovered. Most of them, however, are not isolated in the processing procedures now in use, and, indeed, the properties of and extent to which many of them are present are not known. Examples of these materials are the phosphatides, sterols, vitamins, antioxidants, saponins, and numerous other substances.

The soybean research of the Bureau of Agricultural and Industrial Chemistry is devoted to the development of markets in both the food and the industrial fields. My remarks have emphasized industrial utilization because that has been the guiding thought behind the operation of the former U. S. Regional Soybean Industrial Products Laboratory and the four Regional Research Laboratories. It should not be assumed, however, that the industrial utilization of soybean products approaches in importance the requirements of the food and feed industries. There are great possibilities for expanding all of these outlets and a vigorous program of research toward this objective should prove to be good insurance against a post-war depression in the soybean industry.

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Inoculation and

NITROGEN NUTRITION

of Soybeans

By A. G. NORMAN

THE WIDESPREAD adoption of soybeans brought with them for us certain land-use problems, for which answers were not available but for which solutions will be needed if this most interesting and valuable crop is to have a permanent place in our agriculture. We need to know how to fit it into the rotations that suit the type-of-farming areas of the state; we need to know the fertility level that is most efficiently used in production of beans; we need to know the nutritional requirements of the soybean plant and the effects, if any, which this crop may have upon the soil and upon succeeding crops.

I do not bring you the answer to these questions. Indeed, our whole program comes under the category of unfinished business induced by war and interrupted by war. All that is possible now is to indicate some of the lines along which our thoughts have been running, one or two of the theories formulated and the direction of some of the experiments that have been carried out to test them.

Let us start with the most unprofound statement that the soybean is a legume and, as such, has the property of entering into a symbiotic relationship with certain bacteria, as a result of which nodules are formed on the roots and nitrogen made available to the plant. In other words, the soybean plant, while capable of taking up soil nitrogen as do other plants, has supplementary means of obtaining nitrogen. To a considerable extent, it would seem that on the relative contribution made by these two nitrogen sources—soil nitrate by normal absorption and atmospheric nitrogen through the activity of bacteria in the nodule—ultimately hinges a substantial part of the answer to the land-use and fertility problems that face us.

SOYBEANS AND NITROGEN

It is another remarkably unprofound statement to say that, though the total weight of material produced by the soybean crop per acre is not exceptionally high, it is a crop that is relatively high in nitrogen. For every bushel of beans roughly 3.6 pounds of nitrogen is required, apart from that left in the straw. The state-wide average yield for Iowa since 1939 is 19.2 bushels, which means 69 pounds of nitrogen. The straw and roots of a crop of this size account for about 25 pounds more, making a total of 94 pounds nitrogen for an average crop of beans.

Now, the average corn yield for the same period has been in the neighborhood of 54 bushels, which requires about 54 pounds of nitrogen. If an additional 30 pounds be added for the stover and roots, one arrives again at a total of about 84 pounds nitrogen. Since corn does not have a supplementary source of nitrogen, the inference is that Iowa land of average fertility must provide at least 80 to 90 pounds of available nitrogen per acre during the growing season, which amount would theoretically be almost sufficient to provide for an average yield of beans without any contribution through the nodule.

● *Have we been expecting too much of the nitrogen-fixation mechanism of the soybean plant? Dr. Norman presents some evidence which points toward that possibility. The author, formerly biochemist to the Rothamsted Experiment Station in England, has been professor of soils at Iowa State College since 1937. At present he is in Washington on leave doing work in connection with the war effort.*

Alternately, one could say that theoretically there is enough nitrogen to allow an unnodulated bean crop to produce an average yield of beans and this is certainly the case on land producing better than average corn yields. The question at once arises as to the contribution which the nodule makes, and whether a nodulated bean plant makes a lesser demand on the available soil nitrogen than an unnodulated plant and whether it is efficient land-use to grow a crop that has a supplementary nitrogen source on land that contains sufficient or almost sufficient nitrogen for the crop without the aid of the supplementary source. The issue is point of balance between the two sources of nitrogen available to the soybean plant. Does one take precedence over the other?

Does most of the nitrogen present in a nodulated bean plant come from the air, even if there is plenty of available nitrogen in the soil, or does the plant primarily use nitrogen from the soil, so that the contribution made by the bacteria in the nodule is small?

The problem, therefore, is to attempt to determine the source of the nitrogen in the bean plant, which, frankly, is not easy. Most methods of approach have to be indirect; they can, of course, be made in the field or the greenhouse.

The first possibility might be to compare the nitrogen content of an unnodulated crop with a nodulated crop on the same land. All the nitrogen present in the unnodulated crop must be soil derived, but is it a safe assumption to say that the difference between this and the amount found in the nodulated crop must have been fixed from the air? A possible conclusion would be that both crops took at least 62 pounds of nitrogen from the soil, but that the nodulated plants supplemented this with 26 pounds from the air. This, however, is not safe, because an unnodulated legume is not physiologically the same plant as a nodulated legume, so that uptake from soil by the latter might conceivably be higher or lower than that by the former. Only safe conclusion is that *probably* 26 pounds of nitrogen were fixed but the amount might well be more, or might conceivably be somewhat less.

Information on the relationship between the amount fixed from the air and the amount of available nitrogen taken up from the soil should, however, be obtainable by varying the latter. This amounts to asking the question as to whether the amount fixed has anything to do with the amount of soil nitrogen available. This can more readily be studied in the greenhouse than in the field. I have results of such an experiment very carefully conducted in soil of relatively low available nitrogen content, which latter was increased or decreased by various applications. If fixation is independent of soil nitrogen, then the yield and nitrogen present in the crop should not be altered by the additions made to the soil.

DIFFERENCES IN YIELD

The results show substantial differences in yield between the various series. in which the dominant variable was the amount of available nitrogen in the soil. The growth was roughly proportional to the available soil nitrogen present, despite the fact that possession of the nodule mechanism of fixation might be considered to have made them independent of the soil source. Lowering the soil nitrogen by the addition of straw produced a decrease in yield and nitrogen in the plants; raising it moderately, as in the 1 gram application, or substantially, as in the 3 gram application, increased the yield and the nitrogen in the crop.

This experiment leaves uncertain the source of the nitrogen that actually went into the plant. Nodules were present in all cases, but there is no way of telling, for example, in Series 4 how much of the 2057 mg. found in the crop came from the 3000 mg. added plus that in the soil, and how much was acquired by fixation from the air. If this were known, it would be possible to say whether an increasing level of available soil nitrogen within limits causes the plant to be able to fix more nitrogen or whether it is used alternatively and less nitrogen is fixed.

This can now be tested by hanging a tag on the nitrogen added to the soil so that if the same kind is found in the plant, it will be known to have come from the soil. To do this, a form of nitrogen, called an isotope, that is fractionally heavier than that which occurs normally is used. Chemically it is identical and the plant does not distinguish between it and the normal form. If the soil nitrogen is mixed

with, say, 5 percent of the heavier kind, and if later the nitrogen in the mature plant is examined and found also to contain 5 percent of the isotope, it is certain that all the nitrogen in the plant came from that added to the soil. If, however, 2.5 percent only is found, then the conclusion is that only half came from the soil, the other half being derived from the air through the fixation mechanism.

This isotopic nitrogen technique is quite recent, and, incidentally, is applicable to the study of many problems of nitrogen fixation.

In one such experiment, increasing quantities of nitrate were added to inoculated soybeans in a soil of low fertility. The applications were made, not in one large amount initially, but in eight equal amounts at weekly intervals. The first conclusion from this experiment is that, as shown before, the yield of the nodulated plant is affected by the level of available nitrogen present. The plants receiving a high level of available nitrogen outyield the plants receiving a lower level, despite the presence of the supplementary source of nitrogen provided by the nodule. Secondly, there was an appreciable amount of nitrogen fixed even at the highest rate of nitrogen application. The column for nitrogen fixed does not distinguish between that taken from the air and that from the soil organic matter, but the latter can be assumed to be low because of the nature of the soil used in the test. Increasing the available soil nitrogen, then, does not appear proportionately to reduce that which is fixed.

These experiments might seem to be rather artificial, and the next step is to test these results in the field. Experiments were conducted on immediately adjacent terraces on Marshall silt loam that differed only in the fact that, while one had been in a rotation which included a legume for about nine years, the rotation on the other included no legume. Since soybeans had not before been grown on the land, it was possible to include also inoculated and uninoculated plots. A hilltop nearby with deeper topsoil, and that also had had a legume in the rotation, was also used.

FERTILITY LEVEL

As the general fertility level increased, so also did both yield and nitrogen in the beans from the uninoculated plots. This is as one would expect but the same was the case in the inoculated beans, the growth of which, despite the presence of the supplementary nitrogen-fixing mechanism, was nevertheless affected by the fertility level, which in this experiment would be manifest primarily in the amount of available nitrogen present in the soil. In fact, the apparent benefit of inoculation or, more properly, the difference between unnodulated and nodulated plots are proportionately less as the fertility level improves. Moreover, a yield of almost 23 bushels was obtained in an uninoculated crop, which bears out the original contention that these prairie soils do ordinarily provide sufficient available nitrogen for a good yield without any contribution from the nodule. This is not, however, to be interpreted as an argument against inoculation.

The next point to consider is why the level of soil nitrogen should have this apparently dominant influence on the ultimate growth and yield of the plant, which one might expect would be rendered independent of it, if nodulated. It is necessary to remember the relatively short season of growth of this crop. Like other plants, its growth curve can be represented by a flattened S, at first slowly rising, then rapidly, then slowly levelling off. If the plant is to make the maximum yield, it should not be limited for nitrogen through the middle season period. The question arises then as to whether the nodule in this short mid-period of 30 to 40 days can provide as much as the plant can utilize. If not, then any additional available nitrogen in the soil should show dividends in yield. In the same experiment some uninoculated plots were treated with an excess of nitrogen applied as urea at the rate of 94 pounds per acre at planting time and 64 pounds additional late in July, approximately 70 days after planting. Beans so treated and without nodules significantly outyielded the inoculated beans. Such a heavy rate of application is, of course, not practical, but *the experiment shows that the soybean can effectively use more nitrogen than is provided by the nodule mechanism.*

MIDSEASON NITROGEN

The deduction is that any management practice which tends to raise the available nitrogen in midseason is likely to increase the yield of the crop. The easiest way to do this experimentally would be to make applications of nitrogenous fertilizer at that time. This was done in comparison with similar applications made at planting time. The midseason application gave significant increases in yield in two different experiments in 1943, both experiments being on land of high fertility. In the case of Field A, on some other plots no less than four nitrogen applications were made through the growing season in order to have an excess available at all times. The beans in these plots did not yield higher than those receiving the single midseason application.

Plowing under straw at a heavy rate on the same field did not decrease the yield of beans, and, in fact, increased it slightly but not significantly. However, the combination of straw plowed under in the spring and nitrogen fertilizer applied at mid-season gave the highest yield of all plots. There was a highly significant increase of 4.8 bushels over check, the check itself being at the high level of 29 bushels. The interpretation here is that the effect of the straw was to redistribute the supply of available nitrogen in the soil, somewhat reducing it at the early part of the season when the crop was not large enough to make use of it, and spreading out the effect of that added later.

As mentioned earlier, this amounts to a progress report. Certain things have been established and certain theories formulated. It is clear that the nitrogen nutrition of the soybean is by no means as simple as it might seem. It has been established that even under the best conditions, the yield of the nodulated plant is much affected by the available nitrogen supply, which means that maximum growth cannot be obtained if the plant is dependent on the nodule mechanism alone.

CRITICAL PERIOD

The midseason period appears to be the critical period with respect to use of nitrogen by the plant, and the probability is that any management practice that results in an increase in available nitrogen at this time is likely to result in greater yield. In the management of soybeans in the past, it has perhaps too frequently been assumed that, as far as nitrogen is concerned, the plant would take care of itself because of the presence of nodules. It has been our experience, and I believe the Illinois experience too, that soybeans do not respond well to direct fertilization with phosphate and potash and yet, almost paradoxically, that they do respond to management practices that might be expected to raise the general fertility level of the soil.

It would seem to me that this alone should cause us to wonder whether the available nitrogen in the soil might not be a determining factor in the yield of soybeans as it is with non-legumes, and the evidence which we have been assembling certainly points to the fact that we have expected too much of the fixation mechanism and so have had too restricted an idea of the nitrogen nutrition of this crop.

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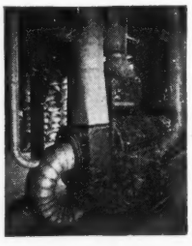

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Some Problems in

USING SOYBEANS AS FOOD

By JEAN I. SIMPSON

IN PROMOTING the use of substantial amounts of soybeans or soybean products as food, several problems present themselves. Probably first among these is the prejudice that many people have against soybeans for table use. Such prejudice is inevitable, for so far as American practice goes, soybeans have been recommended until recently chiefly for low-cost diets. They are unusually valuable when the budget is limited, for they provide generous amounts of the essential nutrients with little expenditure. However, this very association of soybeans with low-cost meals has created an impression that although they are nourishing, they are not palatable.

Those of us who have worked extensively with soybeans and soybean products do not feel at all that low palatability is characteristic of these foods. On the contrary, well chosen and properly prepared, many of them are exceedingly attractive. To convey this fact to the public is the responsibility of those interested in the success of the soybean industry. There are a number of ways of accomplishing this purpose. Some of the colorful and attractive advertisements and booklets now being distributed in connection with soybean products are bound to stimulate interest in them and to encourage consumers to give them a trial.

CAREFUL DIRECTIONS

Piquing interest in this manner is important to be sure, but if the industry is to hold a good market for them it is even more important that consumers be pleased with the results the first time they are used. If success of this kind is to be achieved, the directions accompanying the products must be carefully prepared. This is asking a great deal of the laboratories where recipe testing is done and also of those in which the products themselves are developed.

One of the most difficult problems with which we are confronted in using soybean products as food arises from the lack of standardization of soy flours on the market at present. There are three types generally available, the minimum-fat or no-fat soy flour with less than 1 percent fat, the low-fat flour with approximately 5 to 8 percent fat, and the high-fat or full-fat soy flour with 18 to 24 percent fat. An investigation is being conducted in the food research laboratory of the Department of Home Economics at the University of Illinois to compare the baking quality of these three types of soy flour and also to determine the variation in quality between the different samples of the same type of flour. Results of this study are not yet ready for publication, but it can be said that decided differences in a number of important respects have been found between the three types of soy flour, and greater differences than might be expected between various samples of the same type.

● *Soy foods, well chosen and properly prepared, are exceedingly attractive but their wide acceptance depends on proper processing, standardization and appealing to people's tastes. Dr. Simpson has been a member of the Department of Home Economics staff of the University of Illinois since 1941, when she left a teaching position at the University of Toronto. She has been manager of the Chicago Club and a member of the editorial staff of Curtis Publishing Co.*

Such variability in baking quality is inevitable between flours which differ in chemical composition and in physical properties as widely as do these three types of soy flour. According to data available, they vary from less than 1 to almost 25 percent fat, from 35 to more than 50 percent protein, from 3.5 to 6.0 percent ash and from 1.5 to 5 percent fiber. Furthermore, these same flours have been found to display differences in certain physical properties which determine baking quality. Evidence has been obtained for instance, to show that they differ considerably in their water-absorption capacity, their degree of granulation, their weight per unit volume and their color. Finally, they differ according to the distinctness of the flavor they impart to the baked product, and this is extremely important from the standpoint of consumer acceptance.

With as much variability as this between the soy flours now being marketed, trouble is almost bound to be encountered by consumers in using them. To be sure, many companies distribute directions for using their own particular soy flour, and some of these are fine indeed. If consumers always use the directions for the flour for which they were intended, the results should be successful. But in all probability, sooner or later, these directions will be used with other types of soy flour and then disappointments may result. Such experiences will be confusing and will be apt to make consumers look upon soy flour as unreliable. There can be no question then, but that if soy flours are to have a permanent place on the market they must be of uniformly high quality. And it will be a tremendous advantage from the consumer point of view, if they can be of one type, whatever that type may be. Independent laboratories also will be more inclined to develop ways of using soy flours if these products are standardized.

It hardly needs to be said that many people who have worked extensively with soy flours earnestly hope that they will not be shelved when the present emergency is over. To be sure, they do add significantly to the nutritive value of products in which they are used and hence they are of special interest when foods high in essential nutrients are scarce.

In addition to this unique contribution, however, soy flours when properly used can greatly enhance certain baked products from the standpoint of palatability. Evidence for this is available in the popularity of certain griddle cake and waffle mixes containing soy flour. These mixes give products which are superior in color and have a characteristic richness of flavor and a pleasing texture.

HOME BATTERS

The same can be said of similar batters prepared at home, and this high degree of palatability can be obtained in general with quick-breads and with some kinds of cookies, even when quite large proportions of soy flour are used. Yeast breads and shortened cakes can also be satisfactory when prepared in part with soy flour, though the proportion of soy flour must be smaller unless a product differing considerably from the standard one prepared entirely from wheat flour is to be considered acceptable.

A particularly important caution in the recommendation of soy flours for use in home baking is to avoid suggesting too large amounts. Due no doubt to overzealousness on the part of those promoting them, some directions suggest considerably larger proportions of soy flour than can be expected to give standard or even acceptable products. While this practice may sell more soy flour for the initial trial, it is short-sighted, for the products will be poor and the continued use of soy flours will be discouraged. In the opinion of some, this is the most commonly made mistake on the part of promoters of soy flours at the present time.

VEGETABLE SOYBEANS

The immediate difficulty encountered in suggesting soybeans for table purposes is that a number of people have attempted to cook the field types of soybeans and have found them inedible in many instances. As a result, soybeans have come to be looked upon as unfit for human consumption. Efforts will need to be taken to overcome this prejudice and there can be no question but that once many people have sampled good varieties of vegetable soybeans properly prepared, their enthusiasm for them will be aroused and the demand for them will grow.

Another problem at the moment seems to be that not enough seeds of good vegetable varieties are available to meet even the present demand. Throughout Illinois and in all probability throughout other states, many families are growing vegetable soybeans in their Victory Gardens and are well pleased with the results of their efforts. The outcome will probably be an increased demand for seeds and it is cer-

tainly to be hoped that seeds of the best rather than mediocre varieties will be available. Measures should be taken to see that desirable varieties reach the enterprising people who are willing to try them in their own gardens.

Considerable interest has been aroused recently in the use of vegetable soybeans at the green or immature stage. The season during which fresh green soybeans are available is rather limited, and hence arises the problem of finding suitable methods of preserving them so that they may be used over a longer period of time. As for many fruits and vegetables, the method which retains the original qualities of the soybeans is freezing. Frozen green soybeans in fact, are so palatable that it seems unfortunate these vegetables have not been quick frozen in large quantities and placed on the market. There have no doubt been numerous problems that have interfered with this possibility, among which are the difficulties in harvesting the soybeans and in preparing them for freezing. It is to be hoped that the time may be not long distant, however, when American people may be able to buy quick-frozen soybeans, just as they are now able to buy quick-frozen lima beans and peas.

Other methods of preservation result in more drastic alterations in the original quality of green soybeans. From the standpoint of preventing spoilage, there is no reason why soybeans should not be preserved by canning. But the canned product has a distinct flavor, and one to which people respond variously. Some consider them as satisfactory as other canned green vegetables but others find their flavor quite unpleasant.

It has been felt by some that commercial methods of canning are less detrimental in their effect on the flavor of green soybeans than are home methods, a difference due no doubt to the greater speed with which the temperature in commercial retorts can be raised and lowered, thereby minimizing the time the product is hot. It seems that dehydration is the least satisfactory method by far, for the flavor of the soybeans has been described as unsatisfactory.

Mature, dried soybeans offer an excellent means of making these vegetables available the year around. The choice of variety is as important for these as it is for the green soybeans, if flavor and texture are to be a matter of concern. The dried soybeans may be used much as navy beans are used, but it is better to encourage people to become acquainted with their possibilities on the basis of their own interesting qualities rather than on the basis of their resemblance to any other kind of bean.

ENCOURAGE APPRECIATION

Appreciation for the characteristic texture of soybeans needs to be encouraged. The fresh, green soybeans look not unlike lima beans and hence people rather expect them to taste like lima beans. Similarly, dried soybeans look much like dried navy beans and so they are expected to taste like navy beans. But in texture particularly, the soybeans are quite unique, for they are somewhat nutty in contrast to the softness of other legumes. A mistake too frequently made is prolonged cooking of the soybeans in an attempt to make them soft. This is neither necessary nor desirable. Instead, people should anticipate this characteristic of soybeans and look upon their nutty texture as one of their attractive features.

Considerable publicity has been given during the last year or two to the preparation and merits of soy sprouts. This has been done through popular and semi-popular publications particularly, and the value of the sprouts as a source of ascorbic acid or vitamin C has been strongly emphasized. If dried soybeans of suitable varieties are used, sprouts may be prepared without a great deal of trouble and they form an interesting addition to our meals served either as a hot vegetable or cold in salads. But some recent determinations of the ascorbic acid content of the sprouts have raised serious questions as to whether the high value attached to them as a source of this vitamin is quite justified.

These are some of the problems that have presented themselves as soybeans and soybean products are considered for extensive use as food. It is evident that while some of these are rather difficult there are none which in time cannot be solved. In view of the unfortunate prejudice that many people have concerning the use of soybeans as human food, it seems especially important that promoters of these products be cautious in their recommendations, for if consumers are disappointed in the results they obtain, their prejudices will be encouraged rather than dispelled. More research is needed to answer many of the questions concerning the use of soybeans as food, but particularly evident is the need for putting the results of research into practice. Intelligent use of research findings must be made in the home and in the industry where soybean products are prepared.

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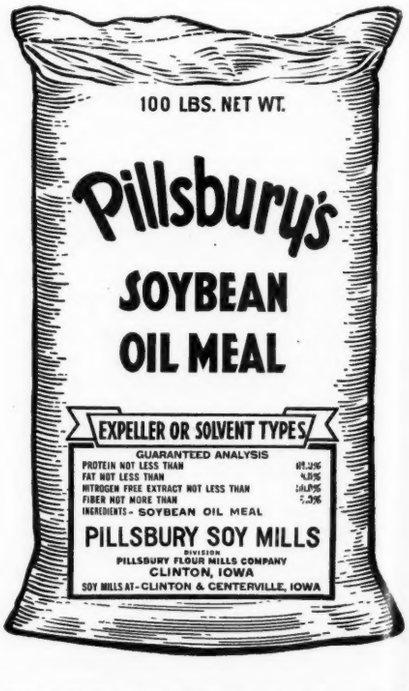

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Utilization of
SOYA PROTEINS IN INDUSTRY

By P. E. SPRAGUE

IT IS a pleasure, as well as a privilege, to discuss this topic with you, because it is one that I have watched very closely and have been intimately connected with for about a decade, and which my business associates have been concerned with for almost a decade prior to that.

I surmise that among the many aspects of this subject, Dr. Burlison had in mind that you would be interested to secure if possible an answer to some questions as these:

What progress has been made in making soya protein available for use by industry?

What progress has been made in the industrial utilization of these proteins?

About how many bushels of soybeans are annually required to sustain this use?

What varieties of soybeans appear to have the greatest value for the manufacture of these proteins?

At what price per bushel to the grower can this usage be continued and enlarged?

What seems to be the long-term and short-term outlook for further expansion and development of this usage?

PRACTICAL VIEWPOINT

My discussion will tackle these questions principally from a business and practical viewpoint.

First, let me remind you that the incentive to try to make and to use soya protein industrially sprang originally from the fact that all types of proteins that had found an established use in manufacturing operations were of animal origin and fairly high in price. Vegetable proteins, such as may be found in corn, peanuts, wheat, flax, etc., while long known, were not regarded as capable of manufacture to sell at prices to compete favorably with the established animal materials. As the soybean crop began to assume worthwhile proportions, the possibility of attempting something with soya protein seemed much more favorable. As the crop became established in this country, we realized that this might become one of the most abundant and cheap sources of vegetable protein, for two reasons—first, because the protein content of the beans is high, running around 40 percent, and also because it seemed possible to grow economically somewhere throughout these 48 states all of the soybeans for which there would be a demand.

There also seemed to be excellent prospects that important uses could be found for the oil, which, if realized, would mean that the protein portion of the bean could be had at a price that would justify the high cost involved in refining or isolating the protein content in a form suitable for industrial use, and the cost of developing and promoting such uses.

On this assumption is seemed probable that industrial use of soya protein could be built up in two directions—one, by preparing such proteins of satisfactory quality and offering them at attractive prices to compete for those uses that already were requiring higher priced proteins, and the other that through research, new uses for the soya proteins could be discovered based on their own unique characteristics, not possessed by the animal or other proteins, that would create a market for them which would be *a new market* and would increase the total protein consumption.

Secondly, I will remind you with great emphasis that soya protein is a very complex and sensitive substance. *1,*2 No discussion about the preparation of soya protein for use or about the methods of use in industry can be followed understandingly without keeping this uppermost in mind. I think the extremely complex chemical composition of all the proteins is becoming more generally recognized in lay circles, but in addition to this, I wish to refer to the *sensitivity* of soya protein in capital letters. By "sensitivity" I refer to the fact that some change occurs in it every time anything is done to it. You men know how sensitive soybeans are to weather conditions during the maturing period, but perhaps you are not familiar with the changes that occur in the protein in the bean during storage, and with every condition that occurs during the processing operations, and with every treatment to which the protein is subjected in attempting to refine it for industrial use, either by mechanical or by chemical methods. We know now that it is absolutely *essential* for either the layman or the research worker who undertakes to talk about the properties of soya protein, to first peg the protein he is talking about by defining precisely how it was obtained and exactly what was done to it in the process of obtaining it and of using it.

For lack of such definition, much of the literature about soya proteins and their use is valueless. Perhaps we should not be astonished about this, because the ablest scientists who have worked with soya protein, either in this country, in Europe or in Asia, have as yet been unable to determine very much about the chemical or molecular structure of it.

HEADACHE— AND HOPE

However, this complexity and sensitivity of soya protein which is on the one hand a headache for those who seek to prepare it uniformly and to develop its uses, is on the other hand a hope of widespread and new applications to come in the future as the ways and the means are found to bring these sensitive characteristics into control and to probe further into the mysteries thereof.

Thirdly, I must remind you that before industrial use of a chemical substance as a raw material on a large scale can exist, three basic conditions must come into being concerning that substance. They are simple:

It must be available in *ample quantity.*

It must possess *sufficient uniformity of behavior,* so that manufacturing processes in which it is used can be continually maintained without trouble.

It must be available at *a price which industry can and is willing to pay,* instead of using a competitive substance or process.

I believe you can see why it is a man-sized job to achieve success with soya protein in industry.

Now to our questions:

PROGRESS REALIZED

It is just about 20 years since the first determined efforts were made to prepare and use soya protein on a substantial scale in United States industry. *3 During these two decades, two general types of soya protein have been prepared and made available —the first are the so-called "mechanically" refined, finely-ground protein compounds. These compounds contain around 50-55% protein, from zero to variable amounts of oil, together with most of the water-soluble and water-insoluble carbohydrates, sugars, etc., originally present in the bean. This general type of product is being manufactured today in commercial quantities by several of the soya processors.

The other general type is the pure protein, or isolated protein, prepared by chemical methods. *5 Although the production of this pure protein, known by the trade name "Alpha Protein," is quite substantial and has been greatly increased since the beginning of the war, it is obtainable currently only in experimental quantities, except for important military uses. I believe this is the only isolated protein manufactured at this time on a *commercial* scale.

Although I am avoiding names in this discussion, it seems only reasonable and fair to say that the outstanding contribution toward the development of the mechanically prepared type protein compound and the discovery of methods of use for same has been made by I. F. Laucks, Inc., of Seattle, *3 and that the outstanding contribution of the manufacture and developing and promoting uses of the pure isolated protein has been made by The Glidden Company Soya Division, Chicago. *15

I wish now to emphasize that much faithful and valuable research and investigative work has been and is now being done in in this field by other organizations than those mentioned, but as of this date the actual usage of soybeans for production of industrial protein products has been principally realized by the two organizations cited.

Now, as to usage: Of the 40 or 50 general applications that have been found in industry under today's conditions, the largest use for the mechanically refined type is in the field of adhesives for plywood and miscellaneous coatings requiring an adhesive binder. The principal use for the isolated protein is in the field of foam solutions, paper coatings, paper sizing, and paints. The relative amount of both types

going into the various applications are very much distorted by the war.

About 100 million square feet per month of water-resistant, 3-ply plywood are currently being manufactured with soybean glue. *11 Due to the superior qualities of Alpha Protein for the manufacture of certain types of emulsion paints, the demand exceeds the supply. No doubt you have all seen the national advertising of a new paint for interior decoration called "Spred"—a product of this type. Improved techniques and processes for the manufacture of coated paper involve the soya proteins. The well-known "Prosize" process for improved paper sizing has been perfected, patented, and is in general use, and is based on isolated protein.

The Ford Motor Co. advise that whereas for the duration they have abandoned the use of soya proteins, at the peak of their use treated soybean meal in core binder compounds was consumed at the rate of about a million pounds annually, and of the several million pounds of thermo setting plastics Ford used annually, about half of this was a soybean molding compound, which in turn contained about one-third soybean meal.

As you know, prior to the war very substantial tonnages of meal were used in the manufacture of mixed fertilizers because of the protein content, and no doubt this is properly to be included in the category of industrial usage. None goes into fertilizers now.

Although the rate was slow, I believe the record of accomplishment is worthwhile. There has been substantial progress made in this country and I believe that we have really made more progress in this field here than has been made anywhere else in the world. It is significant that this progress stems almost wholly from research.

And the failures have been many. A great deal of research and effort has been extended toward developing a synthetic soya wool, or soya protein fibre, for textiles or bristles. Commercial success has not yet come. *6, *8

Certain types of protein films and binders for use in preparing exterior paints and for decorating fabrics have been diligently sought for years, but have eluded us—we just do not know enough yet to achieve success in finding them. Apparently soya protein has not yet realized a worthwhile utilization in the field of plastics, although much of the trail blazing work has been done.

BUSHELS OF BEANS REQUIRED

Exact statistics on the quantity of beans required to sustain the present utilization of industrial soya proteins are not available and recent efforts to assemble accurate figures were not successful. An estimate which should be within 25 percent of correct is 2,500,000 bushels. Fully three-fourths or more of this is required for proteins used in critical wartime industrial applications.

To get the perspective on this you must realize that a 200 million-bushel crop contains four billion, 800 million pounds of protein, a truly "Washingtonian" figure. An example of the relationship between bushels of soybeans and protein consumption can be illustrated on the basis of the Ford Motor Co. usage. The million pounds of core binder yearly required by Ford and the half million pounds of soybean molding compound required when Ford were using these products measured in terms of soybeans would be equivalent to 30,000 to 35,000 bushels—but a drop in the bucket.

It happens that those industrial uses thus far developed require only a small percentage of protein in terms of the finished products made. Consequently you have the apparent paradox of substantial industrial operations involving relatively small amounts of soya protein. Some of the new uses that we hope to perfect in the future, of which the protein fibers for textiles are an example, will contain a much larger percentage of protein and hence step up proportionately the soybeans required.

The answer to the question of what variety is preferred for industrial proteins is short. We do not yet know. What we do know is the fully matured No. 1 and No. 2 yellow beans of normal moisture content give us the least trouble, and we do know that immature beans, black beans, beans having green or frost or field damage are

• *The "horizon is limitless" for expansion of industrial usage of soy proteins if proper conditions exist after the war. But it is not likely that such outlets will soon absorb a significant part of the annual soybean crop. The author has been vice president of The Glidden Co., at Cleveland, Ohio, since 1936. He is a member of the WPB advisory committee on soybean processing and of the food advisory committee of WFA. He is the author of "Edible Soy Flour," and numerous articles in technical journals.*

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dangerous for the manufacture of uniform industrial proteins.

The answer to the question of what price can be paid for beans to make industrial proteins lies in the oil market. Since the producer of industrial soya protein is not principally concerned with the oil and since oil may be high or low in value, he cannot relate his position directly to bean prices.

It seems probable that in peace times the producer of industrial soya proteins will need a meal or flake cost of approximately $20 per ton in order to compete in the protein market.

Do not miss the significance of the fact that the 1943 crop of beans was the first which ever went to market on the basis where the oil and the moisture content was recognized from the processor's standpoint nor the recently announced ceiling regulations from OPA which are recognizing the protein content of meal and by-products in terms of penalties for any deficiency.

The officers of your association have been aware of the importance of the oil market to the grower, and I am glad to take advantage of this opportunity to congratulate them and particularly Mr. Howard Roach for the care and interest he took in his testimony in Washington and for the stand that the association took in the matter of margarine legislation. Your officers have been very much more realistic than the National Soybean Processors Association because you have perceived that there can be no preference shown for long by grower or processor between the interests of the users of meal and the users of oil.

The best thing that can happen economically for the further development of industrial soya protein usage is the existence of a good market for soybean oil and a fair average price for soybean meal. This will then produce a good price for soybeans.

FUTURE OUTLOOK

Looking at the short term, since critical war uses for industrial proteins are such an important part of the total consumption today and since these uses are of a nature that leads one to expect them to recede with the war's end, the first result of transfer from war to peace will probably be recession in the present consumption. Another factor to be reckoned with for the short term is the effect upon soya proteins in the adhesive field to be expected from the perfection and commercialization during wartime of synthetic resins. Although there are approximately 100 million square feet of plywood made daily using soya glue, yet 40 percent of all soft plywood and more than 80 percent of all hard plywood is made with other glues than soya and principally with resin glues. The synthetic resins are giving soya protein adhesives quite a race and they are gaining because of desirable performance characteristics. There is little doubt that much important research on soya protein must be completed before this gain on the part of the resins can be arrested.

Favorable short term possibilities lie in the further replacement by soya adhesives of other less water resistant ones still being used in many fields. Also since promising work has been done in the field of soya fibers for the making of textiles I would expect the production of soya fiber to be well launched commercially and in more than one direction reasonably soon.

In looking at the long future, it is well to determine whether the seeds of growth exist in the situation and whether there are potentialities unrealized. Here one is justified in letting the imagination run riot. Soya protein is considered to be the most logical starting point for the production of the amino acids, another large group of vitally important substances not now available commercially. Imaginative writers say that the amino acids when isolated, available and studied may well expect to take the place of vitamins and hormones.

PROTECTIVE COATINGS

There is also a huge field in the manufacture of protective and decorative coatings of types not now possible to produce which will be suitable for new types of finishes, exterior and interior, for coated textile fabrics and for transparent packaging. Indeed the horizon is limitless.

You men know you have to have good seed, good soil, and good weather in addition to the determination to plant the seed and cultivate it in order to harvest satisfactory crops. Similar conditions must prevail in preparing these proteins and developing their uses. Organizations seeking to engage in this effort must be prepared to make substantial venture capital investments, to see a great deal of time elapse between putting money in and getting profits out, and be prepared to build up and maintain substantial research and technical facilities and development personnel.

Also a fair system of patent protection will be one of the elements necessary in this favorable climate. It is unjustifiable from a management and financial standpoint to make preliminary outlays in pioneer work unless a reasonable period after commercial discoveries are made can be provided for their profitable enjoyment when successful, and I think that had it not been that a few basic patents were secured, the progress that has thus far been made in this field would not have occurred.

Another prerequisite is a good state of health of general industrial activity in the United States. When this exists we have many enterprises interested in trying to work out new problems and utilize new things.

Also essential in this climate is a soybean meal market that enables soya proteins to be produced at costs competitive with other industrial proteins.

If such a climate is interfered with, progress will be deferred. If it exists, the first postwar decade will see development that will please you, that will enrich our domestic industrial economy and stand as a still greater example of chemurgy in this country.

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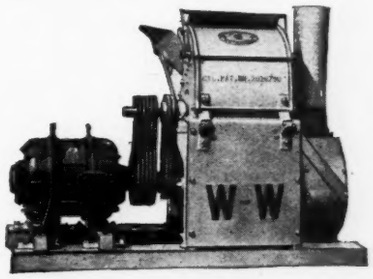

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Facts on SOYBEAN FERTILIZATION

By A. L. LANG

WITH SOYBEANS destined to become one of America's leading crops there is an urgent need for further information on the role of plant nutrients in production. The soybean plant is a strong forager for the chemical nutrients in the soil. For this reason it is well adapted to widely different soil conditions and makes good use of plant food materials remaining in the soil after other crops are removed. In the past, agronomists have been in common agreement that fertilizing materials applied directly for the crop are of little value on good corn land. Recently, however, because of the extreme emergency and the excessive demand for soybean products, acreages have been expanded into marginal areas far beyond the normal adaptational zone. In the marginal areas fertilization and other production problems are acute.

The soybean predates the written page in the Orient and to the present time soil treatment practices used to increase production of the soybean in the countries of its origin have been very simple. Piper and Morse make the statement that in China and Manchuria the only fertilizer applied is a compost of stable manure and earth. In Japan, treatment differs by districts: in some districts straw ashes and phosphate of lime are used, while in others wood ashes and phosphate of lime are used. Manure is also used. These treatments would indicate response to organic matter, calcium, phosphorus and potassium.

• The author makes a thorough report on fertility studies in connection with soybeans up to date. He is associate chief of the soil experiment fields at the University of Illinois, and has been working on soil fertility problems at the university for 24 years.

In the United States there is no record of any fertilizer studies being made on the crop previous to those of Flagg at Rhode Island and Phelps of Connecticut.

Phelps found in studies from 1895 to 1901, that nitrogen fertilization failed to increase the yield or protein content of the beans produced.

Flagg found that applications of 150 to 450 pounds of nitrate of soda were not profitable.

RECENT INVESTIGATION

More recent work on soybean fertilization has been concentrated in the Midwest Cornbelt areas where the acreages have been increasing very rapidly and where the crop apparently is permanently established.

Albrecht and co-workers of Missouri have pointed out in numerous publications the important role of the various nutrient ions, particularly calcium, both in growth and metabolism of the soybean plant. Their work indicates that the marked return from liming materials on acid soils is due more to the effect of the calcium ion than to a correction of soil acidity.

Arnold Klemme of the same station found that, on land where the average production was 10 bushels an acre, lime alone increased the yield 7.3 bushels per acre, and lime plus 200 pounds of 0-20-10 gave an increase of 16.5 bushels. In the same experiments Klemme found that 200 pounds of 0-20-10 per acre was much more effective when applied broadcast and plowed down than when applied in the row at planting time.

In 1942, H. R. Meldrum, of Iowa reported a rather exhaustive study on rates and methods of applying phosphate and potash fertilizers to soybeans on various soil types varying in productivity from 14.6 to 33.1 bushels an acre. Meldrum used 250 and 500 pounds of 0-20-0 and 0-20-20 applied broadcast before plowing, in the plow sole while plowing, and broadcast after plowing. There were no significant returns from this work except on a Webster silt loam relatively low in potassium. On this type the most effective treatment was 250 pounds of 0-20-20 broadcast after plowing.

At Ohio, R. E. Yoder reported the 5-year average response of soybeans to varying fertility levels. The fertility levels were built up by varying the amounts of manure and fertilizer applied to other crops in the rotation. On untreated land the beans made an average yield of 13.1 bushels an acre. This was raised 7 bushels to 20.1 bushels per acre on land which had previously received 8 tons of manure and 800 pounds of fertilizer. Doubling the amount of manure and fertilizer gave no further increase. While 7 bushels an acre is a substantial increase, the fact remains that the average yield after treatment was still relatively low.

Another interesting piece of work reported by Yodder was the effect of fertilizing soybeans in continuous culture. During the first year of the experiment the untreated plot yield was 15.8 bushels. This was increased 0.4 of a bushel with 500 pounds of 0-10-20, 4.0 bushels with 2 tons

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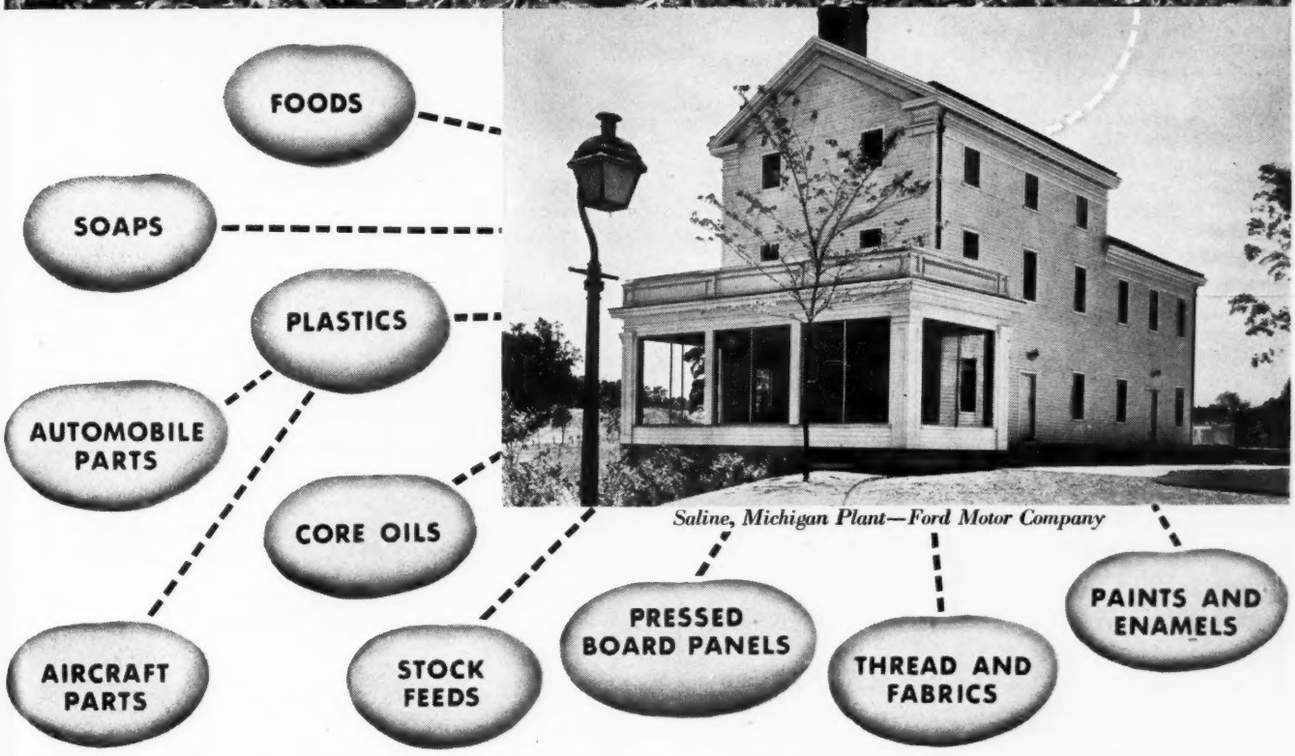

Saline, Michigan Plant—Ford Motor Company

The relatively tiny Ford plant pictured is one of 19 Ford Village Industries. It is located on the banks of the Saline River, 31 miles west of Dearborn.

Neither this plant, bought and reconstructed in 1934 by Mr. Henry Ford, nor any of the other Ford Village Industries plants, on water-power sites scattered through the Michigan countryside, are mere monuments to sentiment. They are thoroughly practical little establishments, profitable and self-sufficient.

The function of this plant is the processing of raw soybeans into oil, meal, and other products. Its output of oil now is meeting essential war requirements. Normally Ford Motor Company uses it in making automobile paints, sand cores for casting, etc. The meal today is a vital part of the huge War Foods program as stock food. In peace time some meal goes into plastics.

Forty men are employed here. Most of them are also farmers, who thus augment the return from their farms with a direct cash income (never less than $6 per working day). Here is a demonstration of the sound economic principle, graphically characterized by Mr. Ford as "one foot on the soil and the other in industry."

But this tangible personal benefit to the 40 workers who man the plant is only one phase of the vivid object-lesson which Saline has furnished for all America to see. Here, also, is proof-positive that vast plant structures are not essential in the linking of Agriculture ever more closely to Industry.

Hundreds of such small local plants are not only practical, but more desirable than a few great centralized establishments would be. They can be built more quickly, financed more readily with local capital, manned more efficiently by home folks, operated more effectively to meet peak harvesting seasons.

And they eliminate much unnecessary transportation of the raw beans.

FARM PRODUCTS REQUIRED BY FORD MOTOR COMPANY IN A NORMAL YEAR

2,000,000 Pounds of Soybean Oil
89,000,000 Pounds of Cotton
800,000 Bushels of Corn
2,400,000 Pounds of Linseed Oil
2,500,000 Gallons of Molasses
3,200,000 Pounds of Wool
1,500,000 Feet of Leather
1,000,000 Pounds of Lard
350,000 Pounds of Mohair

—and with the resumption of peacetime automobile production, this list will grow longer, and the totals of farm products used greater and greater.

FORD MOTOR COMPANY
Dearborn, Michigan

of limestone, and 5.2 bushels by combination of the two. At the end of 4 years the average annual check yield was 15.2 bushels. This was increased 1.2 bushels each year by the annual application of 500 pounds of 0-10-20, 8.2 bushels by the lime (another 2 tons having been applied) and 12.3 bushels by the combination. At the end of 8 years the average check yield was 13.6. The increase for 0-10-20 was 3.1, for limestone 7.6, and for the combination treatment 14.1 bushels an acre. The check plot yield dropped from 15.8 bushels per acre the first year to an average of 13.6 bushels during this 8-year period of continuous culture, while the plot receiving annually 500 pounds of 0-10-20 and during the period 6 tons of limestone increased from 21 bushels the first year to an average of 27.7 bushels for the 8 years.

Using Illinois prices on the Ohio data, $91.40 worth of limestone and fertilizer gave 112.8 bushels of soybeans over the 8-year period.

As far back as 1914, Wiancko, Fisher, and Cromer of the Indiana Station recommended in their Bulletin 172 that it must be thoroughly understood that soybeans cannot thrive without food. Their mineral food must come from the soil. If properly inoculated they can take care of their own nitrogen. If manure can be applied the first time the crop is grown, it will help. On soils naturally unproductive or run-down, satisfactory results cannot be expected all at once. However, with adequate attention to drainage, liming, phosphate and potash fertilization, this crop will do better than most anything else on run-down land. They recommended at that time 200 to 400 pounds per acre of super-phosphate and 25 to 50 pounds of muriate of potash. On sandy or potash deficient soils they advised a heavier application of potash.

ILLINOIS STUDIES

At the Illinois Station, soybeans have been grown on the soil fertility plots of the local farm and outlying experiment fields since 1903.

Burlison and Lang in summarizing their data in 1935, used more than 150 soybean crop yields from 23 soil experiment fields to arrive at the following conclusions: Soybean hay and seed yields are strikingly influenced by the natural productivity of the soil. Dark soils are relatively high yielding in both hay and seed. Light-colored soils are relatively low yielding. Sandy soils are intermediate, with a hay yield of 61 percent and a seed yield of 45 percent of that of the most productive soil types. Yields of hay and seed are markedly increased by systems of soil improvement designed to build up and maintain a high state of productivity for other crops in the rotation. Those treatments which proved to be effective in increasing other crops in the rotation also increased the yields of soybeans. Effective treatments gave larger increases when the crop was harvested for hay than when it was harvested for seed. Therefore, it may be more profitable to fertilize the crop directly when used for hay than it is when used for seed. This also calls attention to the fact that increased stalk and foliage production is not always a safe criterion of increased seed production.

EFFECT OF SOIL TREATMENT

The effect of long-continued soil treatment practices on the physical and chemical composition of the soybean plant are of interest. For 4 consecutive years these effects were studied at the Joliet and Oblong soil experiment fields. Replicated samples of roots, stubble, stems, leaves, pods, and beans were secured at three stages of growth for the various treatments. Moisture-free weights were taken and chemical composition determined for all physical parts.

The soil on the Joliet field is a dark-colored Elliott silt loam having a shallow surface and impervious calcarious subsoil. It is slightly acid, low in phosphorus and medium in potassium. Crops in the rotation respond well to phosphate fertilization. The Oblong soil is light-colored gray prairie Cisne silt loam with shallow surface and noncalcarious, impervious subsoil. It is strongly acid, medium in phosphate and very low in potassium. Crops respond well to limestone, organic matter, phosphate and potash fertilization. Illini soybeans were used on both fields.

Composition data averaged from many sources for several crops point out the relatively large quantities of plant nutrients used in the production of soybeans. A 20-bushel crop of soybeans contains more nitrogen, almost as much phosphorus, twice as much potassium, and four times as much calcium as a 60-bushel crop of corn. The 200 million bushel bean crop raised in the United States last year removed from the soil 300 million pounds of phosphorus and potassium, and 24 million pounds of calcium. The phosphorus and potassium removed from the soil are equivalent to that supplied by 460,000 tons of 20 percent superphosphate and 264,000 tons of 50 percent muriate of potash, respectively. The

(Continued on page 58)

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WATERPROOF TARPAULINS

Creating NEW KINDS OF SOYBEANS

By C. M. WOODWORTH

A STUDY of the soybean crop as it grows under field conditions has brought out clearly the characteristics which are required for successful production and which are the main objectives in a breeding program. These characteristics are as follows,

1. High yield of seed.
2. High percentage of oil and protein.
3. Resistance to lodging, shattering, diseases, insect pests, adverse conditions.
4. Proper maturity.

All these characteristics belong to the class of quantitative characters, and as such are greatly affected by environmental conditions, often require particular conditions for expression, and are usually determined by a large number of genes resulting in a complex mode of inheritance. For example, in breeding for resistance to lodging, plants must be grown under conditions that favor lodging; yield of seed is influenced greatly by differences in soil fertility; and certain diseases and insect pests, resistance to which is sought, may not always be present in sufficient amounts to cause damage and thus to differentiate between resistant and susceptible strains. Hence, breeding for such characters as these is facilitated if lodging or disease epidemics or insect attacks are encouraged by controlled conditions rather than if dependence is placed entirely on natural conditions.

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VERY COMPLEX

Since yield of seed is the end result of all the activities of the plant, it is extremely complex from the breeding standpoint. By that is meant that a large number of genes is involved, perhaps a hundred or more, which differ in extent of dominance, and in their relationship to each other, whether independent or linked. In addition, variations due to growth conditions, though not inherited, are always confusing to the breeder.

Seed yield in soybeans is determined by number of seed and size of seed. Larger yields may be obtained by increasing the number, size remaining the same, or by increasing the size, number remaining the same, or by increasing both size and number. Now, both attributes are inherited but in a complex manner in the sense in which that term is used above. Number of seed is even more complex than seed size being influenced by many things, each of which is also complex.

Varieties differ in their capacity to produce flowers and in their capacity to develop pods from the flowers they produce. Weather and soil conditions are known to affect markedly the amount of flower dropping and the number of seeds that fail to develop in the pods. A further illustration of the complexity of breeding for seed yield is the interrelationship of plant parts. Growing more seeds on the plant must be accompanied by a stronger stem to hold them up and by a larger or more efficient root system to feed them.

With respect to breeding for certain other desirable characters mentioned above, some success has already been attained. However, in many cases the particular character combination, or character grouping, can be improved upon. All the desirable characters are not found together in one variety and many desirable characters are not expressed to the highest degree in the varieties in which they occur. Certain character combinations can be improved upon, therefore, by substituting a good character for a poor one, or by raising the degree of expression of one or more characters. Before attempting to make these improvements the breeder will search for varieties possessing desirable characters or high degrees of expression of characters which he can draw on as sources of good germ plasm. He would arrange his findings in tabular form illustrated by the following:

Characteristic	Source of Desirable Germ Plasm
Shattering	Chief, Illini
Lodging	Richland, Mandell
Japanese beetle	Chief, Illini, Gibson
Oil content	Lincoln, Dunfield
Maturity	Early: Earlyana, Richland
	Late: Chief, Patoka

Illini and Chief rank high in resistance to shattering and Japanese beetle, but they lodge. Mandell stands up well enough and is early, but it is a little low in oil content. Of the varieties listed above, Lincoln ranks highest in yield and oil content, but is damaged more than some varieties by the Japanese beetle. Thus one could go through the list pointing out the good and bad features of varieties. Improving character combinations is one of the main objectives of the soybean breeder.

SELF FERTILIZED

The soybean is a self-fertilized crop. This fact has much to do with breeding methods to create new kinds. The plant does not have to be selfed by hand as does corn. Varieties tend to breed true, but new varieties must be purified before they are introduced to the public for commercial planting. The variety must be a good performer on its own account. What it does in crosses is of interest to the plant breeder but not to the grower. If defective germ plasm occurs by mutation, it will gradually be automatically eliminated.

When a variety of soybeans, however, becomes badly mixed mechanically, it does not automatically purify itself. Since there is a small amount of natural crossing between the off-type and true-to-type plants as they grow alongside each other, the resulting seeds when planted produce hybrid plants. The hybrids will segregate and give rise to a number of combinations, some new, some old, which will in time come to breed true. The variety eventually becomes a mixture of types, probably most of which are breeding true, while the rest are heterozygous for one or more characters.

Soybeans, then, are like wheat, oats, and barley in the method of propagation and in the breeding procedures that are used to effect improvement.

Crossing enables us to accomplish a number of things we cannot accomplish in any other way. These are as follows:

1. Induce variation.
2. Combine desirable characters into one type.
3. Bring together complementary genes for a single character into one type to get transgressive segregation, i.e., exceed the expression of the character in either parent.
4. Obtain and utilize hybrid vigor.

Variation referred to here is genetic variation for this is the only kind which the breeder can utilize.

Usually, the desirable characters are separated into different varieties, and the breeder's problem is to get them together into one variety. Crossing is the only way to do this. Controlled crosses are best but natural crosses have been used with good results. The hybrid seeds when planted produce the F_1 plants; and they in turn, when allowed to self-pollinate, produce seed which give rise to the F_2 plants. The F_2 is the segregating generation and if the parent varieties differ in several characters, a great array of types is presented, representing the various combinations of parental characters in ratios expected on a chance basis. If the objective is to combine some characters of one parent with those of the others, then the F_2 generation is the generation to work upon, as it presents a population of plants with a broad base of genetic variation. In such a plant population, the chances are good, if large numbers are grown, of finding a plant or plants with the particular combination of characters desired.

The foregoing applies also to the problem of bringing together into one type complementary genes for a single character with the objective of attaining a higher expression of the character than occurred in either parent. A good example of this is early and late maturity in a cross between Richland and Lincoln made and studied by Dr. L. F. Williams of the U. S. Regional Soybean Laboratory. From a large F_2 population several hundred F_3 families were grown with several rows of Richland and Lincoln interplanted as checks. Many of these families were earlier than the Richland and many others were later than the Lincoln.

Many crosses between soybean varieties exhibit hybrid vigor. It is generally considered that a hybrid exhibits hybrid vigor if it exceeds both parents in some particular character such as yield of seed, height of plant, or total dry matter of plant.

But this hybrid vigor, even though large in some crosses, cannot be utilized for increased production by the soybean grower. In contrast to corn, soybean hybrids are tediously and painstakingly made by removing the anthers of the flower borne on the female parent and then pollinating with pollen collected from flowers borne on the male parent. An expert hybridizer working every day during the period flowers are available would do well to produce a few hundred seeds in this way.

Consequently, the soybean breeder must try another method. He must try to hold the increased vigor exhibited by the hybrid

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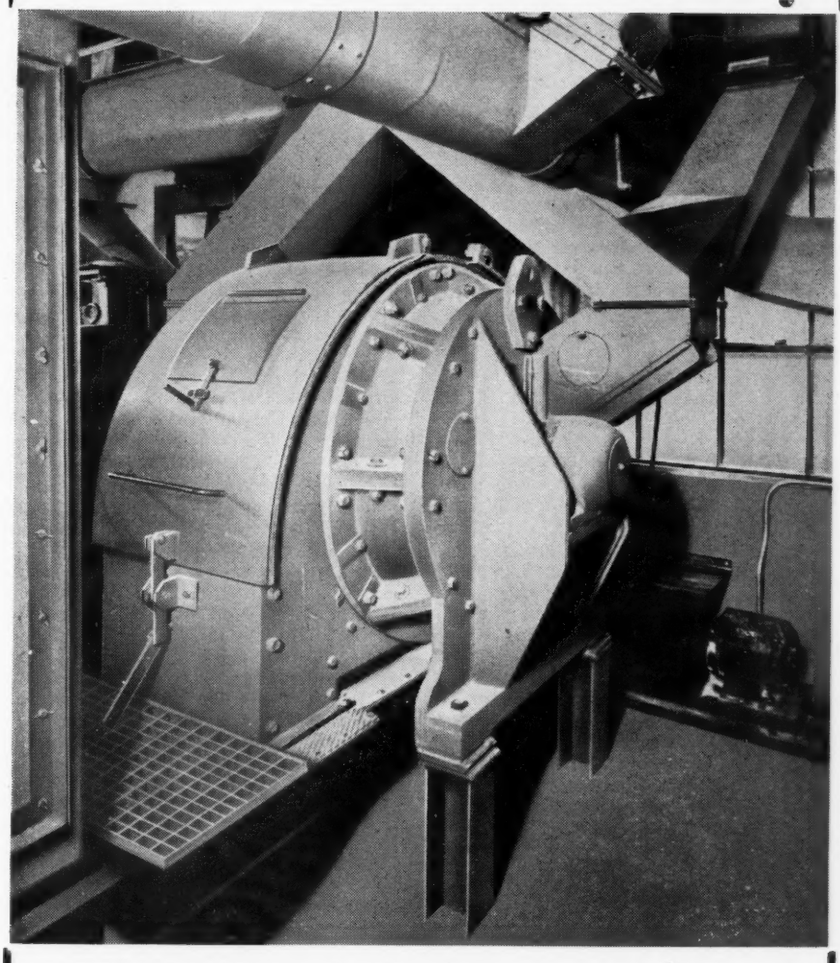

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while at the same time he carries the hybrid down through the F_2, F_3, F_4, and later generations allowing self-fertilization to take place each time. The only way he can hope to hold the vigor is by selection. But in this he is opposed by the principle of segregation which separates and distributes the favorable factors or genes to different lines. Hence, a compromise results and the breeder has to be satisfied with whatever vigor he can hold and still have a true-breeding variety.

SELECTION

Selection is effective only where there is variation which is known to be genetic; that is, within a population of plants which has become genetically mixed through crossing, natural or controlled, and through mutation. Since the individual plant is the unit of selection, single plants are selected, threshed separately, and planted in separate rows for a progeny test. It has been demonstrated often that selection within pure progenies or lines is ineffective. Hence, the problem narrows down to a testing program to determine which of the original selections are the best. If plants selected are pure and breed true, further effort is expended in keeping the resulting lines pure and in testing them. If the plants selected happen to be hybrid for one or more characters, reselections are made within the progenies and tested for purity and performance. Much dependence is put on the progeny test.

It is perhaps not generally known that beginning in 1915 the Illinois Agricultural Experiment Station conducted an experiment on selection within pure lines of soybeans for protein and oil. The experiment was continued for 6 years. Selection was toward both high and low composition. Results showed that selection was powerless to effect a change within pure lines either positively or negatively.

Single plant selection is useful in purifying a variety. Results are much more complete and thorough than by roguing. This is particularly true of varieties having dominant characters such as purple flowers and tawny pubesence. Discarding the off-type plants by roguing does not eliminate the hybrids for they cannot be distinguished from plants typical of the variety. The recommended procedure is as follows: A large number of typical plants are selected from the population. Seed from each plant is planted in a separate row, and resulting plants are examined to determine which rows are breeding true to the variety and which are segregating. The segregating rows are discarded, and the true-breeding rows are harvested and threshed together to make up a lot of pure seed of the variety. This method has been used with the varieties developed at this station, namely, Illini, Chief, Viking, and Lincoln.

The following are examples of varieties that have resulted from single plant selections: Illini, from A. K. Variety; Mandell, from Manchu; Scioto, from Manchu.

MUTATIONS

There are few instances in which varieties of soybeans are known to have arisen as a result of mutation. Piper and Morse in their book on "The Soybean" stated:

"The Trenton is a brown-seeded variety found in a field of the yellow-seeded Mammoth grown in Kentucky. Grown side by side, at the Arlington Experiment Farm, the two sorts were indistinguishable by any other character than the seed color."

The genetic explanation is that the gene i^h restricting brown to the hilum of Mammoth, mutated to i, permitting the brown to extend over the entire seed coat.

A similar mutation has occurred in the Lincoln soybean. The gene i^h which restricts black to the hilum, mutated to i, permitting black to extend over the entire seed coat, thus producing a black seeded Lincoln. The plants are indistinguishable from typical Lincoln plants.

In a sample of Lincoln seed, many seeds are found mottled with black. The mottling is due largely to growth conditions, for when such seeds are planted and plants grown the resulting seeds are typical of the Lincoln variety with little or no mottling. The presence of mottled seeds mars the appearance of a sample or lot, but does not affect the genetic behavior.

Mutations are believed to be unimportant in creating directly new kinds of soybeans for commercial use. Such genetic changes usually affect one character at a time, are recessive, and go in a retrogressive direction.

• *Dr. Woodworth, professor of plant genetics at the University of Illinois, is a pioneer soybean plant breeder and recognized nationally and internationally in this field. He has been with the university since 1920.*

LANG

(Continued from page 54)

calcium removed is equivalent to that in 33,000 tons of 90 percent limestone.

Agriculture and industry alike should become more conscious of these figures and their full meaning to the future prosperity of our country. The figures take on even greater significance when experimentation shows that applied plant nutrients are not used by the soybean plant efficiently and in most cases not even effectively. It is apparent that until more is learned about the feeding habits of this plant, other crops in the rotation will have to pay for extra fertilization, if soil productivity is to be maintained. That is a load not easily carried by the common Cornbelt crops.

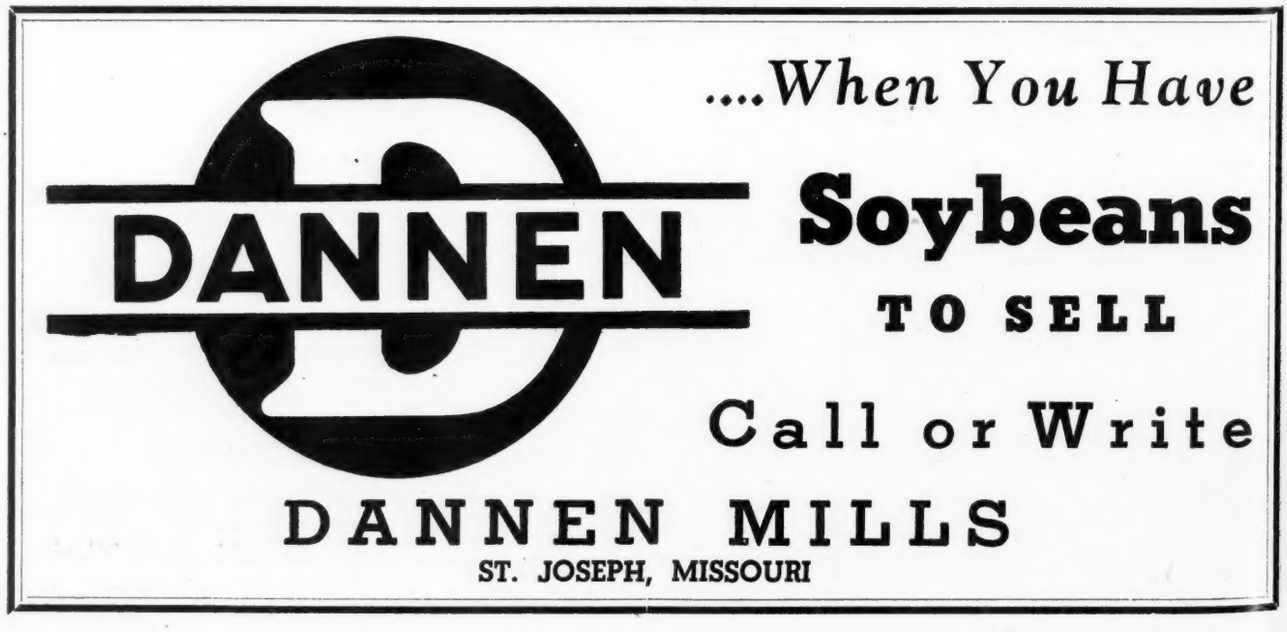
SUMMARY

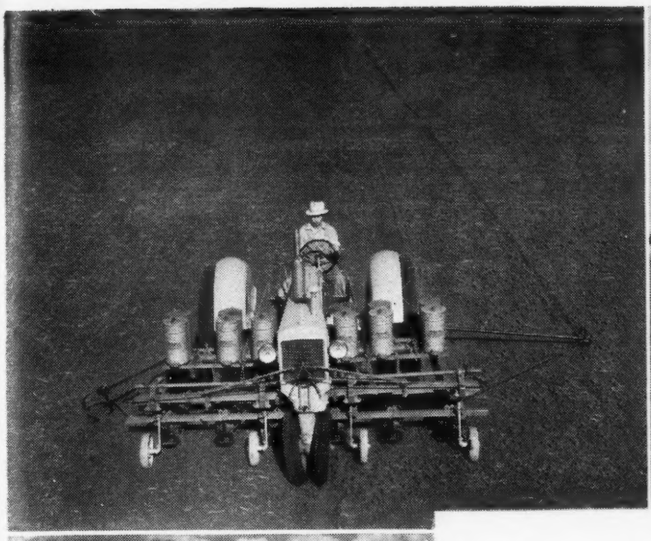
To summarize briefly, the following statements seem to be justified. Soybeans are well adapted to a wide variety of soils and do better on poor run-down acid soils than almost any other Cornbelt crop. They are relatively heavy users of plant nutrients but being strong foragers they do not give expected responses to applications of plant food materials. They do, however, show marked response to variations in natural soil productivity and to treatments which build up soils to a high state of productivity for other crops in the rotation.

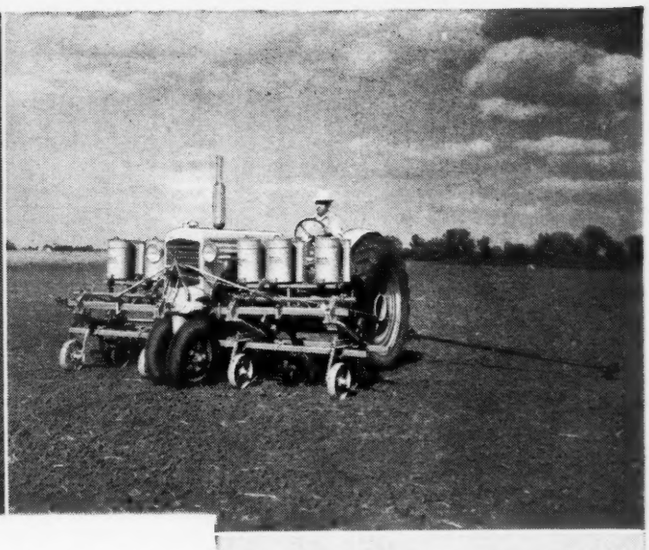
Recommendations commonly made by most agronomists for poor worn out soils are: Supply adequate drainage, lime acid soils, inoculate thoroughly, and apply phosphate and potash fertilizers in accordance with their needs as shown by tests. For good corn land fertilize other crops in the rotation.

Facing us still is the fact that on good or poor land soybean yields may be relatively low yet fail to give expected response to fertilization or soil treatment.

Two lines of research are suggested for the investigator: Are plant nutrients of the right kind being supplied in sufficient quantities at the critical growth periods in the life history of the plant? Are present varieties constituted physiologically and genetically to use plant nutrients efficiently and effectively in greater seed production?







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at the U. S. Regional Soybean Laboratory

● The large number of soybean strains that have been introduced has been a real protection against spread of disease, says the author, who believes there may be danger in growers going hog-wild for one variety. He is associate pathologist in the U. S. Regional Soybean Laboratory.

By WILLIAM B. ALLINGTON

THE U. S. REGIONAL Soybean Laboratory started work on soybean diseases about one year and a half ago.

The control of soybean diseases by the use of resistant varieties is of course the primary objective. A vast amount of groundwork on the epidemiology of the score or more of soybean diseases present in this country, however, is quite vital to a sound program.

Much of the work to date has been in the nature of disease surveys and inspection of variety nurseries in the 24 states serviced by the Laboratory. In general it has been found unsafe to rely upon natural infection with the various parasites in order to select more resistant varieties. Where feasible, therefore, we have started tests and uniformly inoculated the soybean plants in the nurseries with the disease producing organisms. This work has been in progress for only one season and naturally no decisions have been made in regard to disease resistance.

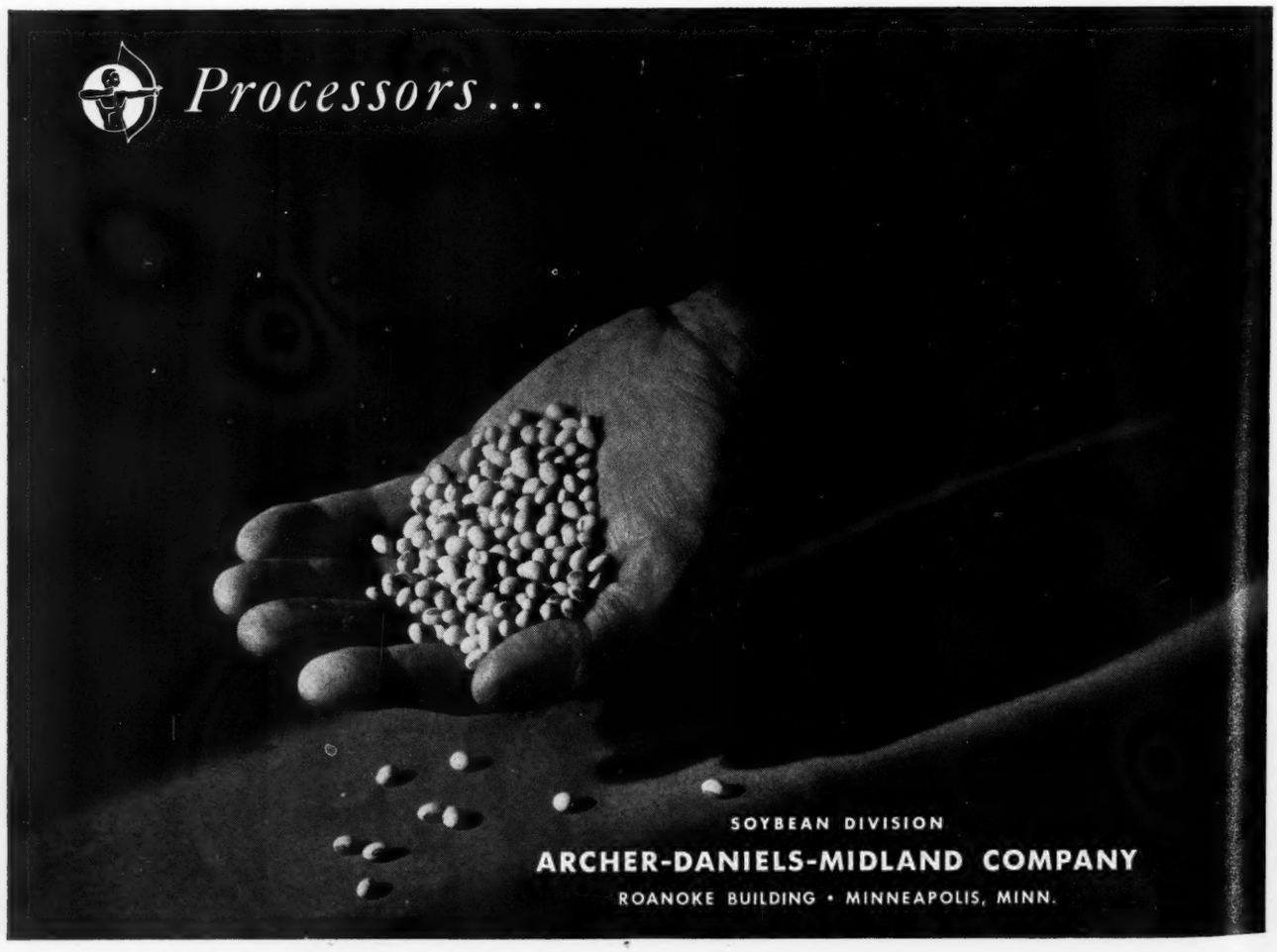
The surveys made in 1943 and 1944 have disclosed six or seven diseases to be of economic importance or potentially so. They may be listed as follows, the more important ones first: Bud blight (virus), bacterial pustule, bacterial blight, sclerotial blight (confined to the South), pod and stem blight, downy mildew and wildfire.

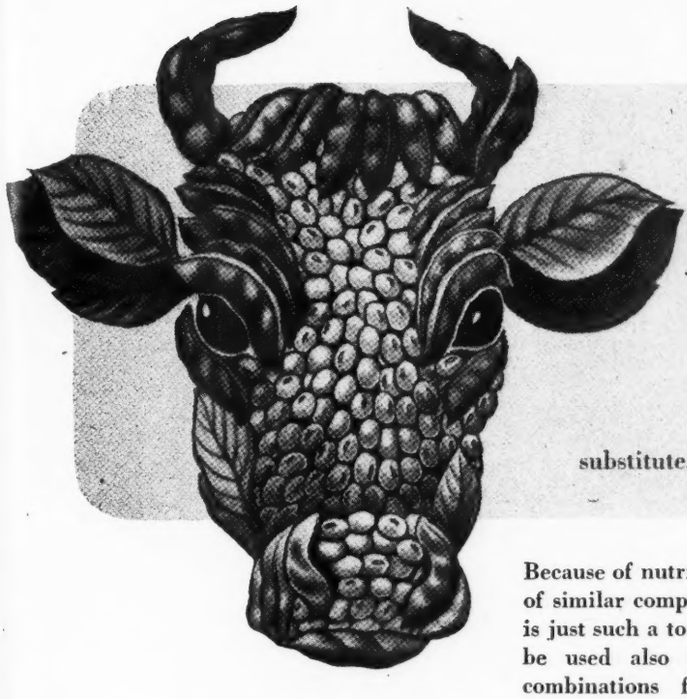
Studies on the epidemiology of bud blight and the bacterial leaf spots have just been started. A uniform chemical seed treatment test was conducted in 10 states in 1943 and expanded to 18 states in 1944. Usually the chemical seed treatments resulted in slightly increased stands but the yields are unaffected. The preliminary results from seed treatment tests on soybeans, therefore, are not promising.

Extensive greenhouse work is conducted in the study of the nature and behavior of soybean diseases. During the past year a new disease of soybean leaves was studied and was found to be caused by a specific bacterium similar if not identical to the bacterium causing wildfire of tobacco. This development is somewhat startling since the disease was found widely distributed in the country and on tobacco, at least, can become very devastating. The total damage to soybeans caused by wildfire in 1943 was insignificant. However in local areas it was found to be serious. It has been found in 1944 in several fields of the Cornbelt and in Louisiana and Oklahoma.

Perhaps the time has come for a word of caution in regard to the extensive use of only a few varieties of soybeans. It appears at present that the new outstanding variety Lincoln, if its present performance is continued, will be planted very extensively in the territory to which it is adapted as soon as the seed is available. From a pathologist's viewpoint this is a questionable procedure, since it may provide the set-up for a widespread epidemic of disease. Lincoln is indeed a superior variety and represents a brilliant achievement by our agronomists. As far as our experience has gone it has no serious weakness as far as disease susceptibility is concerned. It is attacked by all of our common diseases but seems to be as resistant as any of our varieties. However, experience with other crops should tell us that no variety can stand up long against all comers. Unfortunately the parasites that cause diseases are living creatures which continually undergo hybridization in a haphazard but nevertheless effective manner and new forms are continually arising. As long as these new forms come in contact with numerous varieties of soybeans they

(Continued on page 65)





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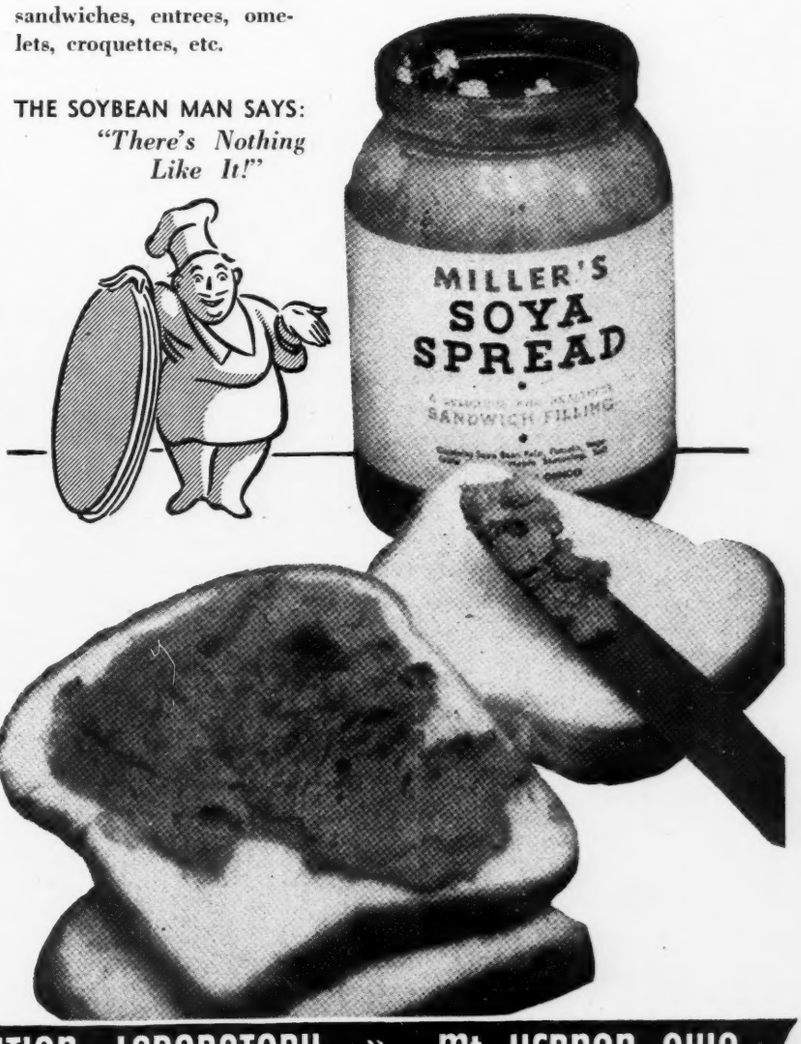

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CARTTER

(Continued from page 22)

the seed. In a 4-year comparison in the Uniform Test, Group II, comprising 49 nursery trials in five states, Lincoln has averaged over 5 bushels per acre higher in yield than the average of Illini and Dunfield.

In the Group III test where it has also been grown for the last 2 years it has shown the same advantage in yield over Illini and Dunfield. In oil content the strain is slightly superior to Dunfield and Scioto, the best in oil of the present commercial varieties, and over 2 percent above Illini. Lincoln has averaged superior in lodging resistance to the common varieties in its maturity class and has excellent seed quality. The variety is adapted in the area where Illini and Dunfield are generally grown and may replace these varieties if its present performance is maintained. This season over 900 cooperators in the soybean belt are growing a total of over 19,000 acres of registered Lincoln seed and there should be sufficient seed to plant nearly 400,000 acres in the spring of 1945.

One of the more important projects of the U. S. Regional Soybean Laboratory is the development and distribution of breeding stocks containing the best of the germ plasm discovered through yield testing and chemical analysis. There is a demand for early varieties, and to supply this need a rather comprehensive group of crosses has been made, including the most important early strains in combination with themselves and with later strains outstanding in yield and composition of seed, resistance to lodging, and other agronomic factors. These stocks have great promise for producing strains for the northern states that are early, high yielding, resistant to lodging, and high in oil content.

Lincoln, one of the superior varieties, has been crossed with Richland, a strain maturing about a week earlier and outstanding in lodging resistance. This hybrid was backcrossed to Lincoln in an attempt to secure a strain with the high yield and oil content of Lincoln and the earliness and lodging resistance of Richland. Such a strain would be of great value in northern Ohio, Indiana, Illinois, and Iowa, and in southern Minnesota and Wisconsin.

Several thousand selections from the backcross are being grown this year in these states in the search for improved lines. Another backcross involving Lincoln and Pagoda, a very early Canadian variety, was made to secure a strain with the yield and composition of Lincoln and early enough for the northern states of the North Central Region. This segregating material has been distributed widely for testing.

DISEASE NOT NEGLECTED

Breeding for disease resistance has not been neglected. A pathological section was added to the Laboratory in the spring of 1943 and an intensive search started to locate disease resistant soybean lines to use in the breeding program. In connection with this study it has been necessary to learn more about the fundamental host-pathogen relationships and the conditions for infection so that the soybean strains in a nursery could be given an adequate test for disease resistance.

A study of the behavior of soybean strains has indicated very clearly that soybean breeding problems cross state lines and that a regional approach to the problem and close cooperation between interested agencies is most desirable, both from the standpoint of economy of operation and of progress in the developing of improved strains. The development of the variety Lincoln is a good example of the value of cooperative testing by several state experiment stations. The establishment of a chemical section in the Soybean Laboratory has made possible for the first time an extensive use of chemical analysis as a very important tool in the breeding work. The cooperation of other bureaus in the U. S. Department of Agriculture and of industrial processors has aided in determining the type of soybeans needed as a raw material for industrial and food use. Thus the increased need for cooperation and the increased dividends resulting from this cooperation are seen in the progress of the work to develop improved strains of soybeans to fill specific needs.

In the future one of the most useful functions of the U. S. Regional Soybean Laboratory will be the production and distribution of segregating material from promising soybean crosses and the coordination of the testing program over the region to provide for the more rapid development of improved varieties and strains.

—s b d—

OIL CHEMISTS

More than 30 papers in the oils and fats field have been promised for the 18th annual fall meeting and war conference of the American Oil Chemists' Society at the Hotel La Salle in Chicago on October 25-27, according to Dr. W. B. Hendrey, program chairman.

F. H. Lehberg, deputy administrator of oils and fats for the Canadian government, will discuss the oil and fat situation in Canada from two points of view: commercial statistics and technical aspects.

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CASE

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WILLIAMS

(Continued from page 34)

it desirable to have varieties containing the greatest possible quantities of oil and protein. The newly released Lincoln variety contains about 1 percent more oil in the seed than most of the varieties commonly grown in the area to which it is adapted. Breeding work is under way in an attempt to further increase this oil content in Lincoln.

A new strain from the Iowa program also looks very promising from last year's uniform tests. This strain has an oil content as high as Lincoln, yields almost as well, stands as well as Richland, and is as early as Richland. In the South the variety Ogden has been found outstanding in oil content, and extensive breeding work is under way to further improve this strain by crossing with other high oil varieties and backcrossing to Ogden in an attempt to retain its high yield, drouth resistance and other desirable characters.

The hybrid material produced in the breeding programs of the various states cooperating in the Laboratory has been made available to other states. In this way a large number of crosses have been distributed as bulked F2, F3, F4, or F5 populations. A number of selections have also been exchanged between the various states to hasten the testing program. On account of this preliminary testing new strains entered in the uniform testing program have a better chance of exhibiting wide adaptability.

This uniform testing program is designed to produce the most information in the shortest time from the effort expended. At present there are eight uniform test groups. In these tests are entered the more promising new strains produced by the various breeding programs as well as a number of standard commercial varieties for comparison. Generally these tests contain from 10 to 25 strains and may be planted at from 10 to 40 locations. The agronomic and chemical data from these tests is summarized and made available to all the cooperating agencies.

—s b d—

CARTER

(Continued from page 35)

ty occurred due to high temperatures. There appears to be a definite value, however, to shading and light colored exteriors that serve to hold down the bin temperatures. High temperatures denote trouble when accompanied by moisture above 12 or 13 percent and where heavy insect infestation occurs.

BIN STRUCTURE

The majority of the bins on the Urbana, Ill., site are prefabricated structures which were secured from the Commodity Credit Corporation. Several bin types are represented, however, and it is expected that after further use, definite recommendations for improvement can be made. The experimental bins involve the use of steel, lumber, and plywood. Other structural materials will be added next year for comparison. Following are preliminary observations relating to the bin structure:

(a) Crushed rock bases were regarded as more satisfactory than the earth fill and block ring types, although somewhat higher in cost.

(b) Some wood bins which were built from damp or uncured lumber resulted in undesirable shrinkages and cracks in the walls.

(c) Wood bins with very narrow roof projections allowed moisture to seep down the walls and cause some damage to the contents.

(d) Most bins are not tight enough to exclude driving rain or snow.

(e) The prefabricated bins used on the project could be definitely improved by more accurate gaging of cuts, bolt holes, etc.; some sections were out of alignment; extra nails and bolts had to be purchased; some braces were improperly cut; considerable fitting and modifying had to be done. In some cases the nailing was insufficient.

(f) Farmer's preference in wood bins is decidedly for the low-walled bins and larger floor areas, since such bins have better utility value for purposes other than soybean storage.

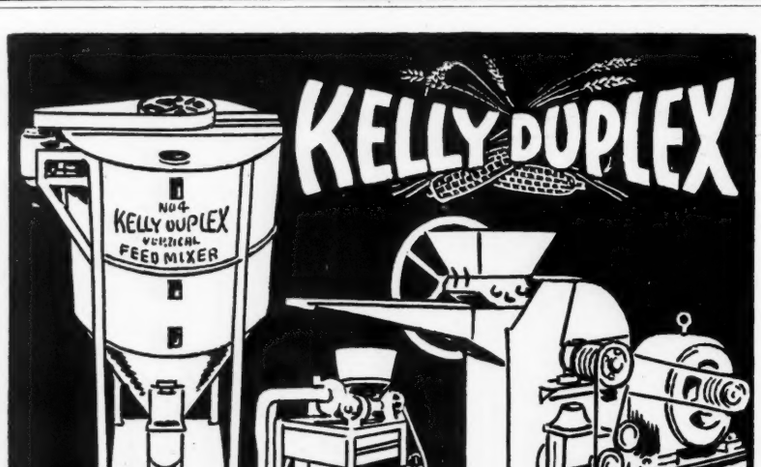
—s b d—

CHEMURGISTS MEET

About 15 directors of the Farm Chemurgic council met September 13 at Urbana, Ill., for an all-morning session devoted to advancement of their program.

Wheeler McMillen, chairman of the council, announced the directors voted to hold the organization's 1945 conference March 28-30 in St. Louis. Membership and support of the council is at a new peak, he reported.

George Cross, president of the University of Oklahoma, was named a new director.



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RESOLUTIONS

(Continued from page 21)

American Soybean Association express its deep appreciation for these research developments to the fine group of capable and interested research workers responsible for these developments to the commercial and federal and state agencies responsible for them. Whereas indisputable evidence exists that the condition with respect to soybean diseases is rapidly becoming more acute, and whereas this condition has been brought to the attention of federal officials on several occasions in the past two years with requests that a modest appropriation be made for the conduct of comprehensive studies looking to the correction of this condition. And whereas, this association at the annual meeting one year ago formally went on record requesting cooperation of the Department of Agriculture as a means of assuring continued normal growth and expansion of the crop, and whereas, an item covering such work was submitted to the Budget Bureau but never attained final enactment, therefore be it resolved that we request a hearing before the chairman of the Budget Bureau and any other interested government officials by a joint committee representing the growers, the processors and the handlers of soybeans at the earliest possible date for the purpose of determining whether proper action can be obtained without necessity of resorting to legislative measures.

(6)

Whereas it has been necessary for the war program to rapidly expand soybean production, and whereas in getting this increased production, growers have in some cases lost sight of best land use and, whereas we fully realize that soybeans are not best adapted to sloping land which is subject to serious erosion, therefore, be it resolved that we recommend that members give full consideration to best land use when planning their postwar agricultural production even though it may mean a modification of soybean acreage on soils subject to serious erosion.

—s b d—

ALLINGTON

(Continued from page 60)

can only occasionally find a few which are susceptible. When we limit the varieties we increase the chances for epidemics caused by the new parasites which find them susceptible.

One reason why the soybean has not been plagued by disease epidemics in this country and was relatively free of disease until recently may be that we have been growing too many different varieties for diseases to get a foothold. The soybean came to this country in the form of literally thousands of collections made in the Orient. The Orientals were growing these different varieties for many reasons. Local adaptability undoubtedly played a large part in the cultivation of a variety. Perhaps tradition also had its effect.

As a result of these introductions and the subsequent cultivation of a host of varieties in this country we may have innocently exercised a very effective disease control measure. The most enthusiastic intelligent plant breeder does not expect to obtain a variety which will be resistant to all diseases or to all new forms of the same disease but he does hope to keep up with them in order to keep crop losses down.

It seems wise at this time, therefore, to keep our eggs in more than one basket and not depend upon one variety of soybeans in our heavy producing areas.

FARRAR

(Continued from page 32)

primarily on cracked kernels. Webbing of the grain surface is common. The rust-red flour beetle, *Tribolium castaneum* Herbst., breeds throughout the grain mass where moistures exceed 10 percent. It feeds on cracked grain, with larvae damaging whole kernels where moisture content of the grain goes above 15 percent. Large numbers of this species give abnormal odors to the grain. The flat grain beetle, *Laemophloeus minutus* Oliv., is common in all bins of soybeans. It breeds freely in spots of grain with high moisture content, feeding primarily on cracked grain and foreign material. The saw-toothed grain beetle, *Oryzaephilus surinamensis* L., is found in small numbers in most bins, breeding on cracked grain and foreign materials. The foreign grain beetle, *Ahasverus advena* Waltl., is common in all bins of grain with high moisture content, or with small areas of decomposing grain caused by leaks in the roof or sidewalls of the bin. They breed freely on soybeans "not in condition," feeding on decaying organic matter. They apparently cannot maintain themselves in dry grain. The hairy fungus beetle, *Typhaea stercorea* L., is common with the foreign grain beetle, breeding under similar conditions.

Insects found in bins but of little or unknown importance are Psocids or book lice, *Liposcelis divinatorius* L., grain mites, several species; two-banded fungus beetle, *Alphitophagus bifasciatus* Say; black carpet beetle, *Attagenus piceus* Oliv.; dermestid, *Trogoderma versicolor* Creutz; *Litargas balteatus* Lee; and long-horned flour beetle, *Cyneaus angustus* (Lec.).

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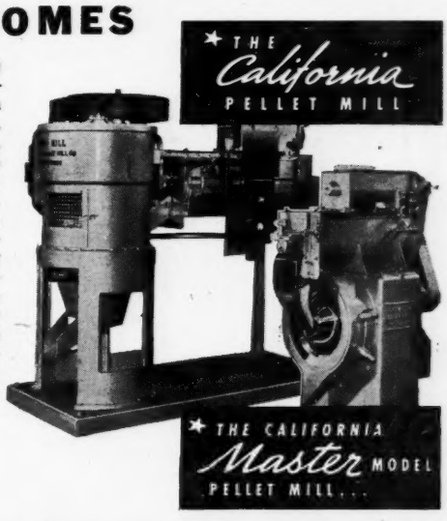

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Crop Prospects Show Improvement

Soybean crop prospects improved somewhat during August and the national estimate is 466,000 bushels above a month ago, the September 1 report of the U. S. crop reporting board indicates. Total yield is placed at 179,024,000 bushels, and the estimated yield per acre is 16.8. This compares with 16.5 bushels estimated August 1.

The national acreage is estimated at 10,688,000, 1 percent under the acreage harvested in 1943.

A real frost hazard exists in many areas over much of the acreage due to the late maturity of the crop, say *Soybean Digest* crop correspondents. Their September 1st reports follow:

ALABAMA

Ben F. Alvord, Dept. Agricultural Economics, Auburn: Maturity normal. Expected yield 90% on hay, seed, 6 bu., total yield same as 1943. Expect some worm damage. 90% crop cut for hay.

ARKANSAS

Charles F. Simmons, extension agronomist, Little Rock: Maturity somewhat behind normal, though ahead of 1943. Rainfall exceedingly spotted. In some areas crop better than normal, in others poorer. In some areas acreage greater than 1943; in others less. Arkansas will probably produce more beans than in 1943. Per acre yields lower than 1942, but greater acreage will probably result in greater total production.

Jacob Hartz Seed Co., Stuttgart, for Stuttgart trade territory: Maturity 90% normal. Expected yield 12 bu. per acre, 95% normal. Total yield 80% 1943 20% for hay.

ILLINOIS

Russell S. Davis, Clayton for west central. Maturity 2 weeks late, some planting failure due to lack of moisture to germinate. Expected yield 85% normal, per acre 20 bu. Considerable increase in acreage should produce higher total yield than 1943. Early plantings have made very tall growth, considerably lodged by recent 2-day drizzling rain. Mid-season plantings just now reaching full growth. Late fields still have some bloom. Third of crop in danger Oct. 1 frost. Doubt if 10% will be cut for hay.

A. E. Staley Mfg. Co., Decatur, for central: Maturity 1 week late. Expected yield 80-90% normal, per acre 22 bu. Total expected yield slightly under 1943. Early frost would damage small amount depending on weather during September. 1-2% for hay.

Frank S. Garwood & Sons, Stonington, for south central: Maturity week to 10 days late. Expected yield 75% normal, per acre 20 bu. Total expected yield 10% under 1943. Crop most uneven in years. Fields vary from good to very poor, depending on date of planting, and amount of rainfall. This section deficient in rainfall from June 1 to Aug. 21. All late planted soybeans, fairly large acreage, subject to frost damage.

J. E. Johnson, Champaign, for east central: Maturity 80%, expected yield 85% normal, 20 bu. per acre. Total yield 10-15% under 1943. Early frost would reduce yield and impair quality. Only earliest seeded fields show yellowing of leaves. Many outstanding fields will doubtless yield in 30 bu. bracket. High percentage of late seedings will cut average materially. All plants shorter than normal; podding not as low to ground as normal. A hot, dry September would be salvation of crop.

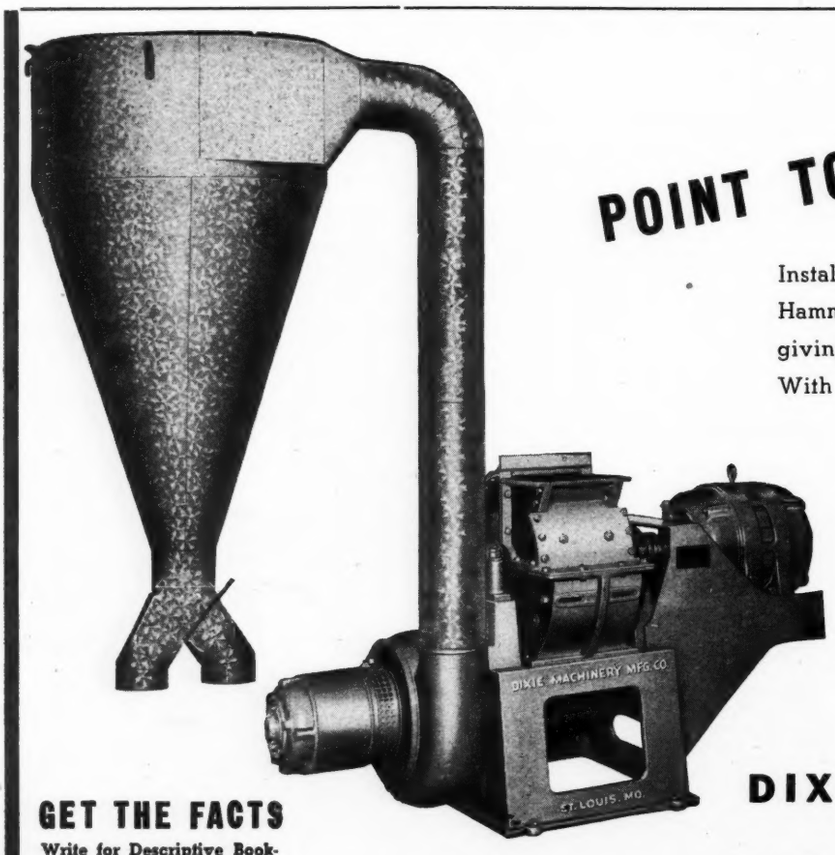
A. J. Surratt, Dept. of Agriculture, Springfield: Prospects have been maintained since Aug. 1. Prolonged drought caused considerable permanent injury to many fields in drier areas, mainly from southeastern to lower west central and uneven conditions in other scattered dry spots. For state as whole these losses offset by improvement in bean production outlook elsewhere resulting from good soybean weather since August 16 break in drought. This particularly true of later half of crop. Part of crop as far advanced as usual, probably one-fifth now turning color. With normal weather many fields ready to combine Sept. 25. These comments assume moderate hopper damage and that killing frosts will hold off until average dates which range from around Oct. 1 in northern to Oct. 20 in southern counties. Loss risk from frost to late beans, also from grasshoppers somewhat more than usual.

INDIANA

K. E. Beeson, Indiana Corn Growers Association, Lafayette: Maturity slightly later than normal except on sand where early varieties are ripening. Total expected yield 87% 1943.

Peter J. Lux, State AAA, Indianapolis, for central: Maturity 10 days later than normal. Per acre yield expected 13 bu., total yield down 20-25% under 1943. Early frost damage could be very serious to later varieties. Early varieties okay. Percentage for hay at least 3% since last report.

J. B. Edmondson, Clayton, for south central: Maturity spotted, probably



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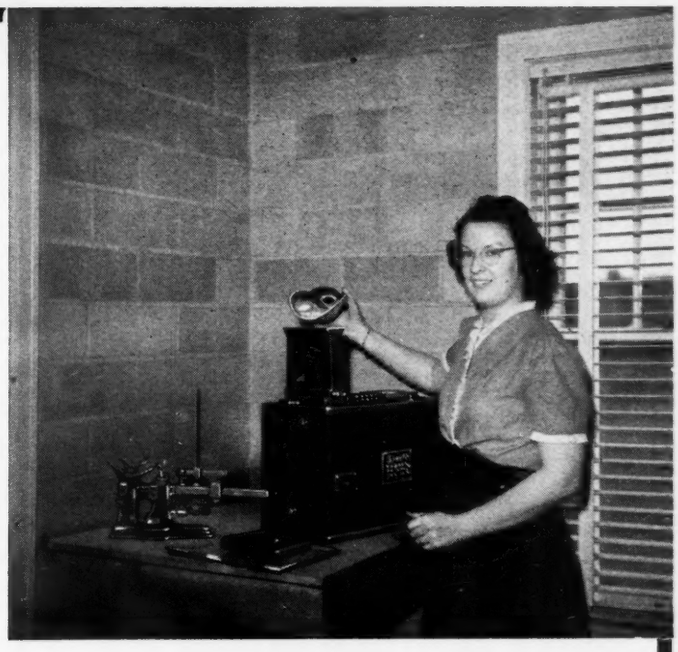

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week to 10 days late. Early planted beans now yellowing, late beans still green. Expected yield early seedings normal, late 75-85%. Total yield 100% 1943, later acreage will balance yield. Threat early frost real for late planted beans. Late rains have stimulated growth and podding. High seed prices and abundance of other hay has about put soybean hay out of picture in this section. Reports from various sections indicate that soybeans sustained less drought damage than corn; further that Lincoln variety well disseminated over state, is giving unusually good account in drought areas. Pod disease showing up here may prove serious later. Fields unusually clean.

IOWA

A. J. Loveland, chairman state AAA, Des Moines: Maturity 90%, expected yield 110% normal. Total yield about same as 1943. 15% possible damage by early frost. Expected per acre yield, 22 bu.

O. N. LaFollette, Feed Institute of Iowa, Des Moines: Maturity, south central backward, southeast good, northeast mostly average, north central slightly backward, northwest, west and southwest about average. Yield near normal, 20-22 bu. per acre, except south central. Expected total yield with normal fall on par with 1943 or slightly under. Except for south central state will show good maturity with good weather by Sept. 30. Very little for hay or silage if beans mature. Let us hope for hot, dry weather until late Sept. Wet, cool month will hurt whole state.

John Sand, Marcus, for northwest: Prospects in making for biggest yield ever. Some fields starting to shed leaves. With mostly early beans in this territory, should be little danger of frost damage. Our Earlianas out of danger in another week.

KANSAS

E. A. Cleavinger, extension division, Kansas State College, Manhattan: Maturity 100%. Harvest will start on early varieties 2 weeks, later varieties 4 weeks. Per acre yield 10-35 bu. Total yield expected 110% 1943, due to higher yield. Possible damage by exceptionally early frost 20%. 5% for hay. 1944 about as perfect a season as we can expect. With exception of 3 weeks in July, moisture conditions have been almost ideal. Eight counties in extreme southeast hit hard by drought. Yield of these counties about 90-95% normal.

MICHIGAN

A. A. Johnson, Farm Crops Department, Michigan State College, East Lansing, Mich.: Maturity mostly normal, 15-20% week late. Expected per acre yield 13 bu., 80-90% normal. Total yield slightly less than 1943. 15-20% would be moderately damaged by early frost.

MINNESOTA

John W. Evans, Montevideo, for southwest central: Total yield expected 110% 1943, 15-25 bu. per acre. Frost would catch 50% in very immature stage. Clean soybean fields have improved position considerably this month. Fields that started out weedy have become worse. Prospects of advanced fields much better than last year.

W. G. Green, Lakefield for southwest: Maturity normal. Total yield 20% above 1943, 20 bu. per acre. We have an increased acreage of about 25%. 65% of crop should mature. 10% has a chance and 25% no chance, will be cut for hay. State of Minnesota has trial plot near Lakefield. Of 8 varieties in plot 3 outstanding for maturity.

MISSISSIPPI

James Hand, Jr., Rolling Fork, Miss.: Maturity 2 weeks late. Total yield expected 50% of 1943, 17 bu. per acre. Acres reduced in favor of small grain. Drought prevented planting of one-third acreage planned.

NEBRASKA

Pete Marr, Fremont, for eastern: Maturity late, due to late planting and excessive moisture. Per acre yield expected, 17 bu., 2 higher than 1943. Possible damage by early frost, 30% central, 10% north and south. Percentage for hay or silage, less than 1%.

NORTH CAROLINA

J. A. Rigney, North Carolina State College, Raleigh: Maturity early plantings normal, plantings after small grain and potatoes delayed by drought. Our crop reduced by lack of seed set, not lack of growth. At this season always have 35 bu. crop. Predictions before Oct. 1 useless. Total yield probably 75% 1943. Percentage for hay or silage determined by weather.

OHIO

D. G. Wing, Mechanicsburg, for central: Early beans very short, turning yellow now. Late beans helped by rain and will be late. Expected yield one-half to less than one-half of 1943. Fields on clay too short to combine. Per acre yield expected 10-12 bu. Late beans need until Oct. 1 to mature. Small amount of beans going to dehydrators. We had 10-week period without enough rain to lay dust. We cultivated 330 acres 3 times and kept beans growing. They will double yield of beans planted solid.

R. D. Lewis & D. F. Beard, Agronomy Dept., Columbus: Maturity normal or ahead. Dry weather of July and August hastened maturity. Per acre yield expected 16-17 bu., total 80% 1943. Very little possible damage by frost unless early 15-20% for hay.

PENNSYLVANIA

L. H. Wiland, Agricultural Statistician, Harrisburg: Maturity about normal. Expected yield probably somewhat below normal because of dry weather. Some late planting may be caught by early frost.

WEST VIRGINIA

R. J. Friant, extension agronomist, Morgantown: Maturity normal. Per acre yield expected 15 bu., 80% normal. 95-100% for hay or silage.

WISCONSIN

Geo. M. Briggs, Agricultural College, Madison: Dry weather helped convert some soybeans intended for seed to hay, materially reduced pod setting, bringing about less seed set and later maturity. Expected per acre yield 8-30 bu., with less total production than 1943. 40% for hay or silage.

John P. Dries, Saukville, for southeast: Maturity 10 days late. Expected per acre yield 20 bu., about normal. Possible 20% damage by early frost. 5% for hay and silage. Writer convinced that row planting should be regular practice in growing soybeans for grain.

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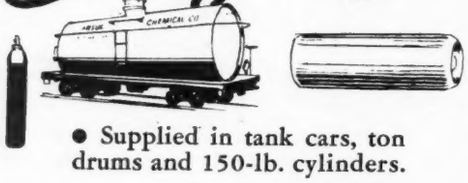

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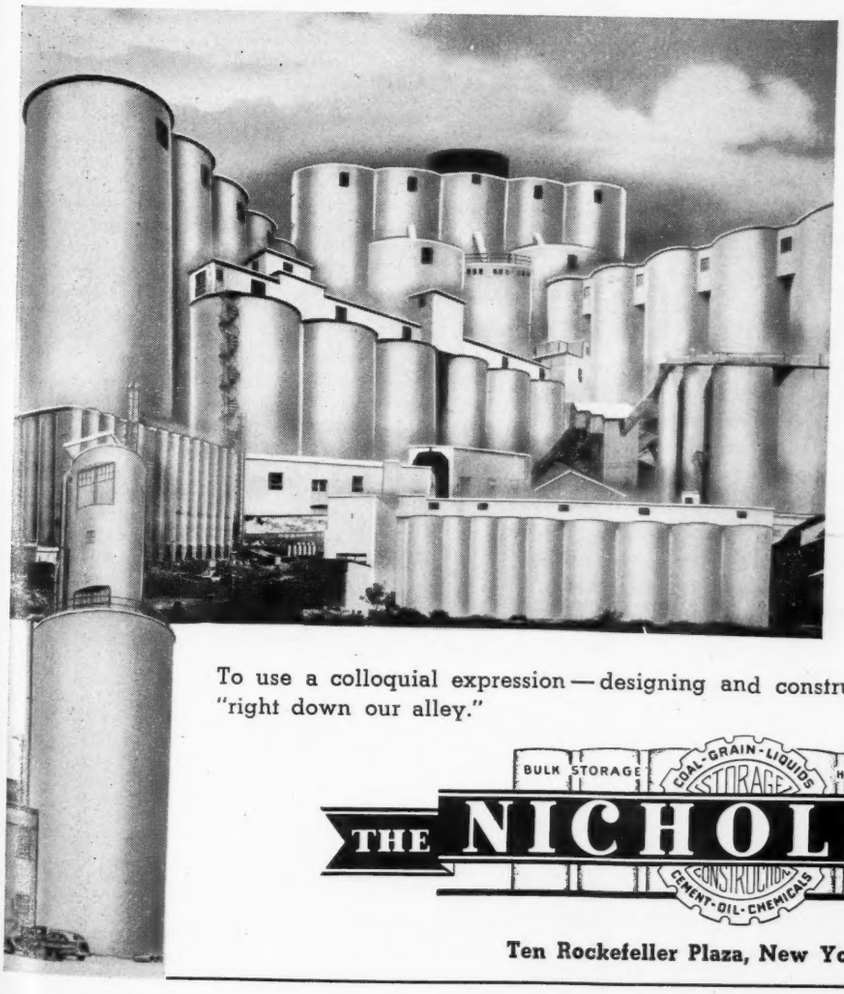

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WASHINGTON DIGEST

By PORTER M. HEDGE
Washington Correspondent for The Soybean Digest

Purchase of 1944 Soybeans

Conditions under which 1944-crop soybeans may be purchased and used are spelled out in a recent War Food Administration order (WFO 110), effective Aug. 25, and aimed at getting all the oil and meal possible from this year's crop.

The order is an extension of WFO 27, a similar order issued last year, but it omits the restriction which prohibited processors from buying, receiving or using soybeans except under contract with Commodity Credit Corporation.

Contracts providing for the purchase of soybeans at support prices, however, have been offered to processors.

Here are the main provisions of the new order:

(1) It prohibits any processor, manufacturer or seed dealer from buying or accepting delivery of 1944-crop soybeans in a quantity greater than his processing, manufacturing, or sales requirements for the period ending Oct. 10, 1945. This, says WFA, is aimed at assuring maximum production of soybean oil and oil meal during the 1944-45 soybean marketing season.

(2) It contains provisions aimed at preventing the holding of soybeans for speculative purposes. It prohibits any country shipper from having on hand at any time after Mar. 31, 1945, more 1944-crop soybeans than he has contracted to sell to processors, manufacturers, or to the CCC, plus the quantity of 1944-crop soybeans he bought during the preceding 30 days, or 2,000 bushels, whichever is greater.

(3) It prohibits any person other than a processor, manufacturer, seed dealer, or country shipper from acquiring soybeans in excess of the quantity (a) required to fill orders on hand at the time of purchase, (b) required to be delivered under contracts with CCC, (c) necessary to meet planting requirements, or (d) to be sold or used for human consumption.

(4) It prohibits any person from buying or accepting delivery of soybeans in whole or ground form for use as feed or fertilizer. An exception to this provision says that damaged soybeans acquired by insurance companies or underwriters salvage companies may be sold for feed or fertilizer if the soybeans are not suitable for processing, manufacturing, or planting.

Growers' Priority

War Food Administration had prepared a first draft of its plan to give soybean growers first call on soybean oil meal processed from the 1944 crop as *The Digest* went to press.

It is expected that the grower priority plan, promised last spring as a result of producer protests over difficulties in getting soybean meal produced from their own crops, will be issued some time this month.

A number of dairy state Senators have complained to WFA that the plan might tend to freeze supplies in the Cornbelt states where most of the soybeans are grown. WFA officials doubt that the plan will result in any upsetting of the normal protein meal distribution pattern.

Final details of the plan have not yet been approved, but here is the general outline:

Soybean oil meal distributed to growers under the priority plan will come out of the 20 percent set aside each month for government-directed distribution.

Growers eligible for oil meal will be issued priority certificates by local AAA committees. The certificates will be tied to livestock. That is, if you have no livestock, you won't be eligible to obtain a priority for oil meal whether you grew soybeans or not. But you still can, of course, obtain oil meal through regular trade channels.

A grower's quota will be based on his minimum livestock needs, or the amount of meal that could be processed from the soybeans he produced—*and marketed.* A grower-feeder will be eligible to obtain only a 30-day supply at one time.

In figuring a grower's quota, protein feeds obtained from other sources—cottonseed, alfalfa, etc.—will be deducted from the total.

It is expected that farm tenants will be given priority certificates based on their share of the soybeans grown. Also, that only landlords with a share in livestock will be eligible for "priority" oil meal.

Payne to Procurement

War Food Administration is slowing up on its heavy educational and promotional work of the past on soya food products.

Don Payne, the popular soya food expert in WFA's Office of Distribution, is moving over to that agency's procurement branch. Payne is expected to coordinate the work of a scientific committee figuring ways of surplus food disposal.

Betty Leaming, another soya food expert and home economist, has left WFA.

A WFA spokesman told *The Digest* that through the work of Payne and his staff and with the aid of the soya products industry facilities have been built up to handle the demand for soya products, and that the main job now is to find outlets.

Rumor Spiked

Taking note of reports said to have circulated widely in recent months that large supplies of protein meal and feed grains have been shipped out of the United States during the last year or so, War Food Administration recently issued a statement saying the reports were groundless.

A WFA spokesman said that total exports of protein meal have amounted to less than one-third of one percent of the amount used within the United States. He said that during the last year protein imports have been more than seven times the quantity exported. These include fish scrap and meal, and vegetable proteins, most of which came from South America.

IN THE MARKETS

SOYBEAN DISAPPEARANCE ABOVE 1943; SMALLER SUPPLIES INDICATED

• **DISAPPEARANCE** of soybeans from the record 1943 crop was 9 percent greater for the first three quarters of the season than during the same period a year earlier, as a result of the urgent demand for soybeans for food and feed. With stocks reduced to about the same level as last year and with a 9 percent smaller crop indicated for 1944 supplies of soybeans for 1944-45 will be less than for the present season but larger than average.

Although disappearance of soybeans during the third quarter of this season was considerably less than in the same quarter a year ago, disappearance for the first nine months of the 1943-44 season was about 9 percent larger than in the same months of the 1942-43 season. This change in the seasonal disappearance was due in part to the early harvesting and marketing of the 1943 crop and the late harvesting of the 1942 crop. Disappearance of soybeans, April through June 1944, amounted to 61,435,000 bushels compared with 68,571,000 in the same months of 1943. Disappearance, October 1943 through June 1944, was 159,883,000 bushels while in the same months of 1942-43 it was 145,769,000 bushels.

Crushings of soybeans for oil and for the third quarter of the 1943-44 season, as reported by the Bureau of the census, were 36,814,000 bushels compared with 43,274,000 during the second quarter and 41,236,000 bushels in the third quarter of the 1942-43 season. Crushings for the first nine months of this season totaled 110,443,000 bushels compared with 103,906,000 in the corresponding months of a year ago, an increase of 6 percent. Consumption of soybeans for flour and grits for food during the April-June quarter amounted to 653,000 bushels and was only a little more than a fourth of the 2,424,000 bushels used during the January-March quarter. However, consumption for the first three quarters of this season totaled 4,897,000 bushels compared with 4,464,000 bushels in the same period a year earlier, an increase of nearly 10 percent.

Stocks of soybeans in all positions July 1, 1944, amounted to 48,422,000 bushels compared with 47,386,000 a year earlier. Stocks at markets and at crushing plants were larger than last year while farm stocks were about 2½ million bushels less. Should disappearance during the fourth quarter equal that of a year ago the carryover stocks on October 1 would be about a million bushels more than the October 1, 1943, stocks of 12,543,000 bushels.

The quality of the 1943 inspected soybean crop is much better than either the 1942 or 1941 crop. Of the inspected receipts of soybeans, October through July this season, 87 percent graded No. 2 or better while only 32 percent graded that well in the corresponding months last season. Inspected receipts of soybeans amounted to 80,916 carlots for the first ten months of this season compared with 71,437 for the same period last season.

A 1944 soybean crop of 178,558,000 bushels was indicated August 1. This is about 9 percent less than the 195,762,000 bushels produced in 1943 but is more than 2½ times the 10-year (1933-42) average of 68,771,000 bushels. The indications August 1 were that 10,853,000 acres of soybeans would be harvested for beans this year which is only 33,000 acres more than last year. The condition of the soybean crop on August 1 was not as good as a year ago and the indicated yield per acre was 16.5 bushels compared with 18.1 last year and 17.1 for the 10-year average.

Based on August 1 crop prospects and a disappearance during the July-September quarter about the same as last year, the supply of soybeans for 1944-45 would be about 192 million bushels compared with 208,305,000 for 1943-44 and 193,155,000 bushels for 1942-43.

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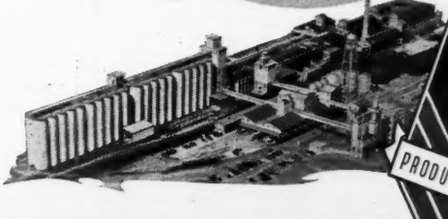

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• **JULY SOYBEAN INSPECTIONS.** The quality of the soybeans inspected in July showed some improvement over the preceding month, 87 percent grading No. 2 or better compared with 83 percent in June, according to inspectors' reports to the War Food Administration. Eighty-seven percent graded No. 2 or better from October through July this season compared with 32 percent for the corresponding months last year. Only 1 percent fell in Sample grade compared with 38 percent last season.

Receipts of soybeans were slightly smaller in July, having shown a steady decrease during the past five months. July inspections were 2,052 cars compared with 2,185 cars in June, 2,874 cars in May, 3,709 cars in April, and 5,066 cars in March. From October through July this season, inspected receipts totaled 80,916 cars compared with 71,437 cars for the same period last season.

Inspections of soybeans in July included truck receipts equivalent to about 19 cars.

• **STOCKS.** War Food Administration report of soybean stocks in commercial storage.

	1943	1944
August 15, bus	1,870,000	2,087,803
August 22	1,473,000	1,922,612
August 29	1,201,000	1,728,458
September 8	1,012,000	1,826,270

• **STANDARD SHORTENING SHIPMENTS.** By members of Institute of Shortening Mfgrs., Inc.

Week ending August 12, lbs.	7,554,881
Week ending August 19	8,232,088
Week ending August 26	7,960,578
Week ending September 2	9,611,290

GOVERNMENT ORDERS

• **WFA ORDER—1944 CROP.** War Food Order 110 (Soybeans), effective August 25, specifies the conditions under which 1944-crop soybeans may be bought and used by processors, manufacturers, seed dealers, country shippers, and others.

The Order is an extension of War Food Order 27, applicable to the 1943 crop. Its provisions are similar to those contained in WFO 27, but it omits the restriction that no processor shall buy, receive or use soybeans except under contract with the Commodity Credit Corporation. Contracts providing for the purchase of soybeans at support prices have been offered to processors.

WFO 110 prohibits any processor, manufacturer or seed dealer from purchasing or accepting delivery of 1944 crop soybeans in a quantity greater than his processing, manufacturing or sales requirements for the period ending October 10, 1945. This provision is for the purpose of assuring maximum production of soybean oil and oil meal during the 1944-45 soybean marketing season.

The Order also contains provisions designed to prevent the withholding of soybeans for speculative purposes by country shippers and others. It prohibits any country shipper from having on hand at any time after March 31, 1945 more 1944-crop soybeans than he has contracted to sell to processors, manufacturers, seed dealers, or to the CCC, plus the quantity of 1944-crop soybeans bought by him during the immediately preceding 30 days, or 2,000 bushels of such soybeans, whichever is the greater.

The Order prohibits any person other than a processor, manufacturer, seed dealer or country shipper from acquiring soybeans in excess of the quantity (1) required to fill orders from processors, manufacturers, and seed dealers on hand at the time of such purchase, (2) required to be delivered under contracts with CCC, (3) necessary to meet his planting requirements, or (4) to be sold or used for human consumption.

The Order prohibits any person from buying or accepting delivery of soybeans in whole or ground form for use as, or manufacture into, feed or fertilizer. An exception is that damaged soybeans acquired by insurance companies or underwriters' salvage companies may be sold for feed or fertilizer if the soybeans are unsuitable for processing, manufacturing, or planting.

• **WFO 9 AMENDED.** The War Food Administration has approved an amendment to War Food Order No. 9 (formerly FPO-9), as previously amended on July 21, 1944, revising and clarifying some of the regulations governing the use of protein meal by mixed feed manufacturers. The amendment is effective immediately.

Changes from the regulations of the existing order include:

1. Quota exemption of protein meals used in the manufacture of range cubes is extended through the fourth quarter of 1944. This exemption, already in effect for the calendar quarter beginning July 1, 1944, and now continued for the quarter beginning October 1, provides that protein meals used in the manufacture of cubes and pellets, containing not less than 30 percent protein, for range feeding of cattle or sheep in excess of the average used for that purpose during the corresponding quarters of the base period years 1942 and 1943, will not be charged against the maximum total use permitted during the year.

2. Urea is excluded from the feed manufacturer's protein meal use limitations. Before this revision, each ton of urea used in the manufacture of mixed feeds after July 1, 1944, was counted against the manufacturer's maximum permitted protein meal use at the rate of 3 tons of protein meal per ton of urea used.

3. "Custom mixed feed" is specified as meaning any mixed feed which is especially mixed for a feeder, but not feed which is especially mixed for anyone for resale. Protein meal used in custom mixing is not charged against or included in the computation of the manufacturer's permitted use.